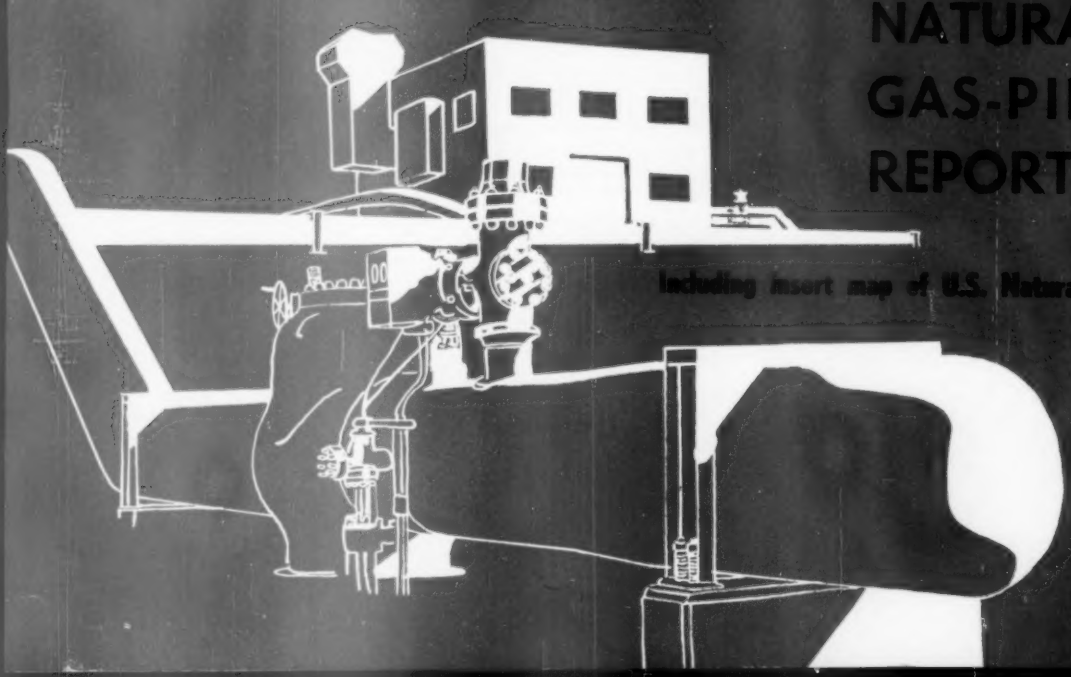
the OIL AND GAS JOURNAL
PUBLISHED WEEKLY March 14, 1960

Tidelands fight is far from over ▸ 95

Harper County: An Oklahoma hot spot ▸ 100

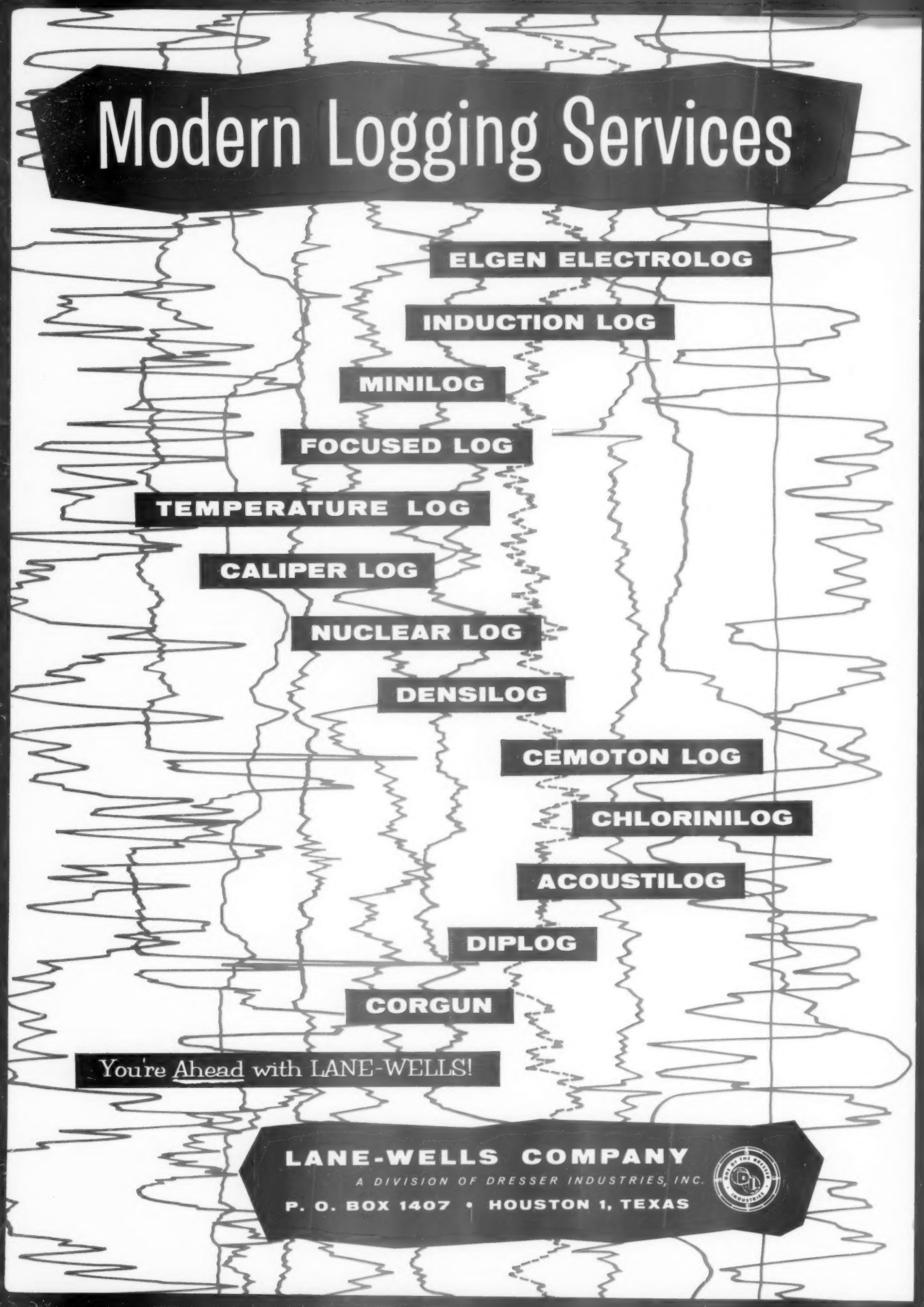
Automatic field is goal at Swan Hills ▸ 106

How to find oil in the Far North ▸ 240



NATURAL-GAS, GAS-PIPELINE REPORT p. 121

Including insert map of U.S. Natural-Gas Pipelines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OIL AND GAS JOURNAL
Vol. 58, No. 11

Contents March 14, 1960

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SPECIAL
NATURAL-GAS GAS-PIPELINE SECTION

Including brand-new insert map of natural-gas pipelines

Better Controls, More Automatic Operation for Gas Pipelines 121
By T. C. Heard

The accepted practice now is to install automatic or semiautomatic start-stop sequence control equipment with new compressor installations. Modern controls are discussed for major types of drive-compressor combinations.

What's Being Done to Give You More Capacity for Your Pipeline Dollar 135
By Gene Kinney

A Journal survey reflects concern that inflation may threaten expansion in the gas industry. Replies from pipelines and manufacturers of pipe and compressor machinery show what steps are being taken to maintain low unit transportation costs.

1960's Biggest Pipeline Uses X-56 Pipe for Entire Main Line 142
By Paul Reed

Winter construction with high-tensile pipe requires preheating for welding and defrosting before coating on the Transwestern Pipeline. Eighty-foot joints are used for the first time in mountainous terrain and a firing-line innovation is introduced.

Domestic Gas Reserves' Future Gloomy Unless Exploration Is Increased 160

Phillips issues a warning that demand is rising faster than reserves are being added; guesses of ultimate reserves yet to be found ignore practical problems and economic incentive for required exploration; revenue from gas sales must supply the major incentive to explore for new gas reserves.

TGT's Delta-Portland System Uses New Station Design 176
By Ross O. Parker, Jr., and Ben R. (Cotton) Keller

Stations are unitized with each unit designed to operate individually, dependent only on the water supply. Outdoor metering, two types of engine control panels, and two types of scrubbers have been used for evaluation.

Standardized Dehydration Plants 180
By F. Zapffe

Now in service for Lone Star Gas Co. are two skid-mounted glycol dehydration plants of identical standardized design applicable to any installation with no added engineering required beyond the main gas piping to and from the contactor.

TECHNOLOGY-OPERATION

Questions on Technology 189

Peewee Pigs Remove Flowline Paraffin 190
By W. B. Bleakley

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New Corrosion Inhibitor Cuts Pull Jobs 198
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How World's Biggest Crude-Distillation Unit Operates 201
By J. Collins and R. A. Holcomb

the OIL AND GAS JOURNAL Newsletter

Tulsa, Okla.
March 14, 1960

Major Oklahoma gas deal is in the mill:

Shell reportedly has quietly put up for bids a big chunk of potential gas production in the Elk City field.

Panhandle Eastern Pipe Line at the moment has submitted the top bid. A contract probably will be signed within a few weeks.

None of the principals will talk until the deal is completed. Trade sources say contract will involve:

...Delivery of 80,000 M.c.f. daily of gas from Elk City field with price to be somewhere near 17 cents per M.c.f.

...Panhandle will build a branch connecting to its main transmission line in Kansas.

Upshot of the development is to squeeze out rumored efforts of the Murchison interests to buy Western Oklahoma and Texas Panhandle gas for a pipeline to St. Louis.

▼ ▼ ▼

It's the swapping season on the products markets.

Refiners with surplus No. 2 want to trade it for nearly any other product rather than carry it through the summer.

Gulf Coast spot markets, as result, are listless. Gasoline is available for plant lifting at ½ to ¾ cents off postings, No. 2 is weak at ½ to ⅝ cents off the posted 8-cent price.

In Group 3 area, No. 2 is selling for 8.25 to 8.5 cents on a firm basis. No. 1 fuel is even firmer (p. 265)*.

▼ ▼ ▼

Stakes in the tidelands boundary battle between Louisiana and the Government are getting higher.

During 1959, nearly 47% of crude and condensate produced off Louisiana and 68% of the gas came from the two zones in dispute (p. 95).

Idea of producing an entire oil field automatically is getting stern test in Swan Hills region of west central Alberta (p. 106).

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*Refers to article in this issue giving more details. Where no page is given, the item is a Newsletter exclusive.

Pan American and Home Oil are leading the way there to a completely automatic operation.

Pembina field is now the largest in areal extent on the continent.

Alberta Conservation Board has combined lands formerly contained in Keystone, Carnwood, Lobstick, and Pembina into one area. This whole Cardium-sand and Belly River-sand oil producing region in central Alberta will be known as Pembina.

Remote triassic gas production is reported at a wildcat 75 miles southeast of Fort Nelson in northeastern British Columbia. Calvan A-29-A Tommy Lakes flowed 1,575 M.c.f. daily during tests at 3,012-50 ft. Well is 30 miles northwest of Laprise Creek field.

▼ ▼ ▼

Czechs report 58% yields of acetylene and ethylene from methane feedstock using a new a.c. electric-arc method.

Present commercial electric-arc process for acetylene manufacture yields no more than 45% from methane feed.

Growing importance of petrochemicals is given unusual emphasis in new study.

Phillips expects that as much as half of its net profit could ultimately come from chemical operations, according to study made by First Boston Corp. (p. 114).

Smog-control law probably will be passed soon by special session of California legislature.

Guess is 1962 models will have to be equipped with control devices before they can be sold in Los Angeles and other thickly populated areas. Earlier models will be required to have the equipment the next year (p. 110).

▼ ▼ ▼

Total net income after taxes of $2.63 billion has been reported for 1959 so far by 97 oil and refining companies.

This is a 14% gain from same firms' income in 1958.

Comparison: Manufacturing companies generally showed a 27% gain in profits during 1959, according to study made by First National City Bank of New York.

Costs of oil exploration, development, and production may not be surveyed as planned by Bureau of Mines.

Instead the API, IPAA, and Mid-Continent Oil and Gas Association may continue similar studies they have made in the past. The Bureau is leaving decision up to industry.

Oil statistics: Rotary rigs down again last week to

1,660. Completions also down by 56 to 739 for week. And domestic production off 122,900 bbl. daily to 7,209,640 bbl.

▼ ▼ ▼

Favorites of stock buyers in the monthly investment plans are Jersey Standard and Phillips Petroleum, according to the New York Stock Exchange.

Jersey rates fourth among the top ten and Phillips eighth.

Other oil issues among the top fifty are California Standard 18th, Gulf 30th; Texaco 39th, and Socony 49th.

Oil and gas stocks still cut quite a figure in portfolios of the big mutual and closed-end investment funds.

Nine of the 58 issues in which the funds have invested $50 million or more are oil and gas company common shares. Value of the petroleum shares is $931 million out of $5.27 billion invested in all 58 shares.

This heavy investment explains why the investors currently have teams of experts quietly touring the oil country checking on the health of both the domestic industry and individual companies.

▼ ▼ ▼

Gas expects to get the lion's share of industrial market growth in California as well as the home-heating market.

Studies of future markets presented FPC supporting pipeline projects count on 80% of industrial business for gas and 20% for fuel oil.

Crews are making fast time on the Transwestern pipeline. About 470 miles or 70% of the 670-mile stretch from Roswell, N. M., to Topock, Ariz., has been welded.

All pipe laying will be completed by late May. Cleaning and testing will be finished by July 1. Article on features of this project starts on p. 142.

▼ ▼ ▼

Industry lawyers are following two other antitrust price cases now that victory has been won in "Tulsa case."

Both could have sweeping effects on pricing and dealer relations. They are:

...Pure's "Birmingham case."

Federal Trade Commission challenges price allowance which Pure gave its dealers in Jefferson County, Ala. The hearing examiner ruled that Pure committed unlawful "territorial price discrimination." This injured competing unbranded competitors by permitting Pure dealers to sell gasoline within 1c of unbranded stations. Pure appealed to the commission which has remanded case to examiner for more evidence on geographical price discrimination.

...Sun's "Jacksonville case."

FTC here challenges price allowance Sun gave a single service station dealer in Jacksonville, Fla. Examiner held the allowance violated both the Clayton Act and the Federal Trade Commission Act. Commission sustained the ruling and Sun has appealed to the Fifth Circuit.

▼ ▼ ▼

Interesting deals:

Phillips Petroleum reportedly has option to buy Pacific Driller No. 1, only mobile drilling platform on West Coast. It's cheaper to buy and convert the driller than to buy a tailor-made permanent platform. Phillips owns part interest in two parcels off shore from Santa Barbara County.

Sunset International Petroleum really has a diversification move afoot. It has paid $7.5 million for a 4,000-acre subdivision under development in San Diego. Through a subsidiary, Sunset will build 8,000 homes on the acreage by 1968.

▼ ▼ ▼

Notes on trouble spots abroad:

Venezuela's proposed national oil company is getting some opposition from a powerful Caracas voice. El Universal, the country's leading newspaper, editorialized last week that the pet project of both President Betancourt and his oil boss, Dr. Juan Pablo Perez Alfonzo, has no "economic justification."

El Universal added the national company would face technical and economic difficulties which it couldn't solve.

Dr. Perez Alfonzo is ready to ask Venezuela's Congress to vote $750,000 as initial capital for the new company.

Thorny problem of an Arab boycott of oil companies operating in Algeria was sidestepped last week by the Arab League's economic council meeting in Cairo.

Council postponed any consideration of boycott until next year. League's oil committee recommended the boycott last fall. The problem: Some of firms in Algeria also have tremendous operations throughout Arab Middle East.

▼ ▼ ▼

Engineering schools are expected to award 37,415 engineering degrees in 1960 compared to 37,965 in 1959.

Petroleum graduates will total 660 compared to 685 in 1959; mechanical 8,350 compared to 8,425; chemical 2,975 compared to 3,025; and electrical 9,400 compared to 9,500.

Engineering enrollment, meanwhile, is down for the second straight year. Students registered in engineering this year total 240,063 compared to 249,950 last year and 257,777 in the 1957-58 term.

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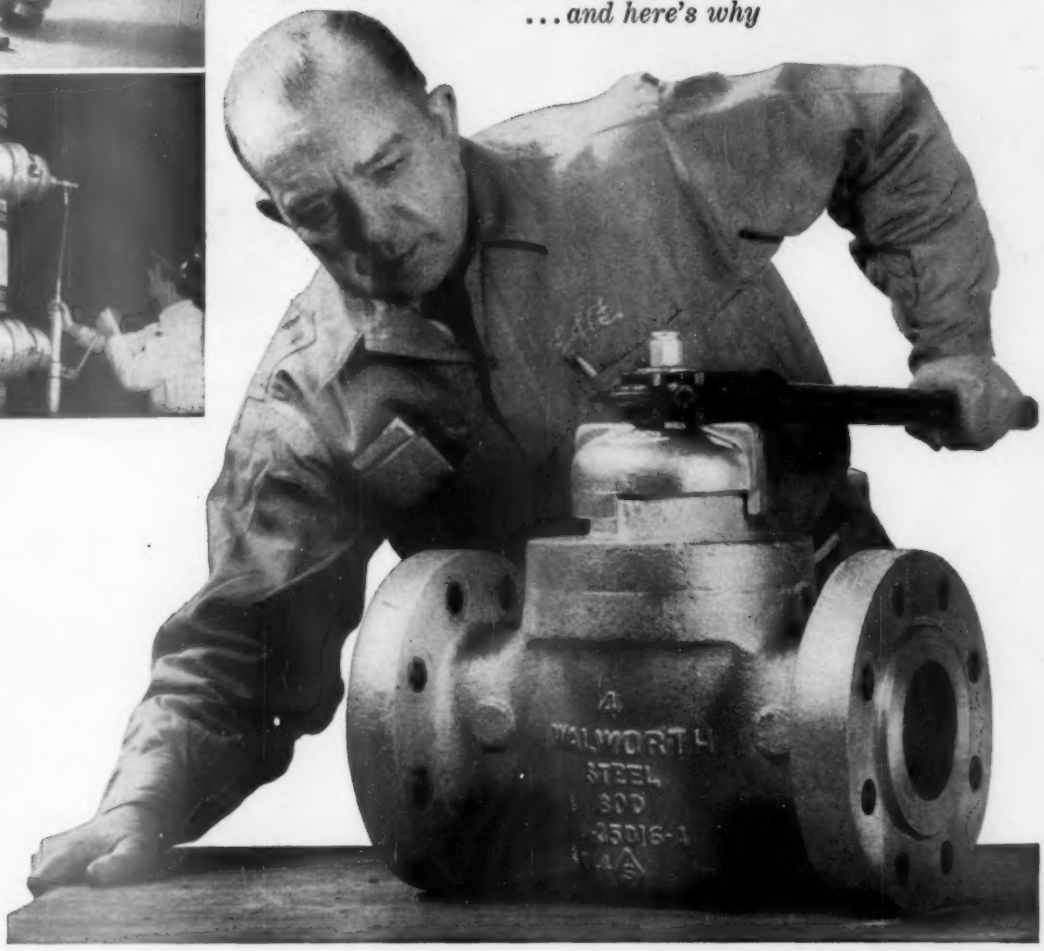

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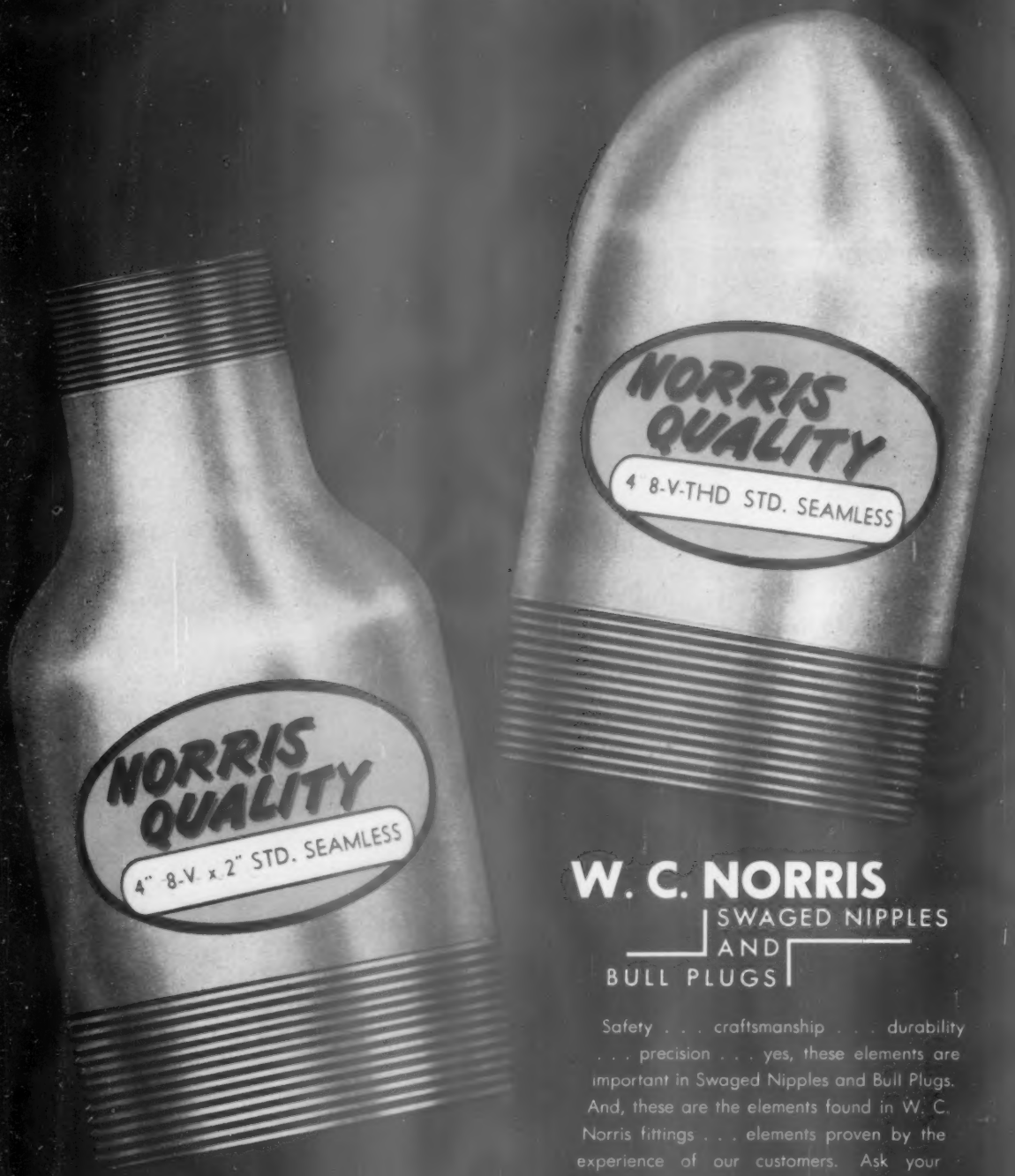

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If your pipe line zigs when you expect it to zag,

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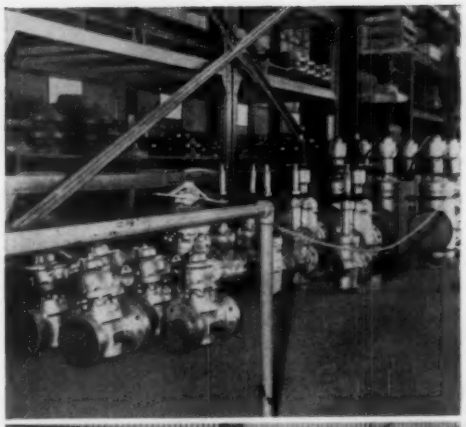

There are many occasions in pipe line construction when plans must be changed on the spot. In such an event, you need have no worry about where to get the valves, fittings and other parts to fit the new plan. They are as close as your "Oilwell" representative.

"Oilwell" stocks of important pipe line supplies are so located that we can make delivery to practically every pipe line construction site within 24 to 48 hours. Our stock is varied and ample. Valves, plugs, nipples and other fittings, in all pressures and sizes, are waiting to be shipped as soon as your order is received. The quality of every item is backed by "Oilwell's" reputation for dependability.

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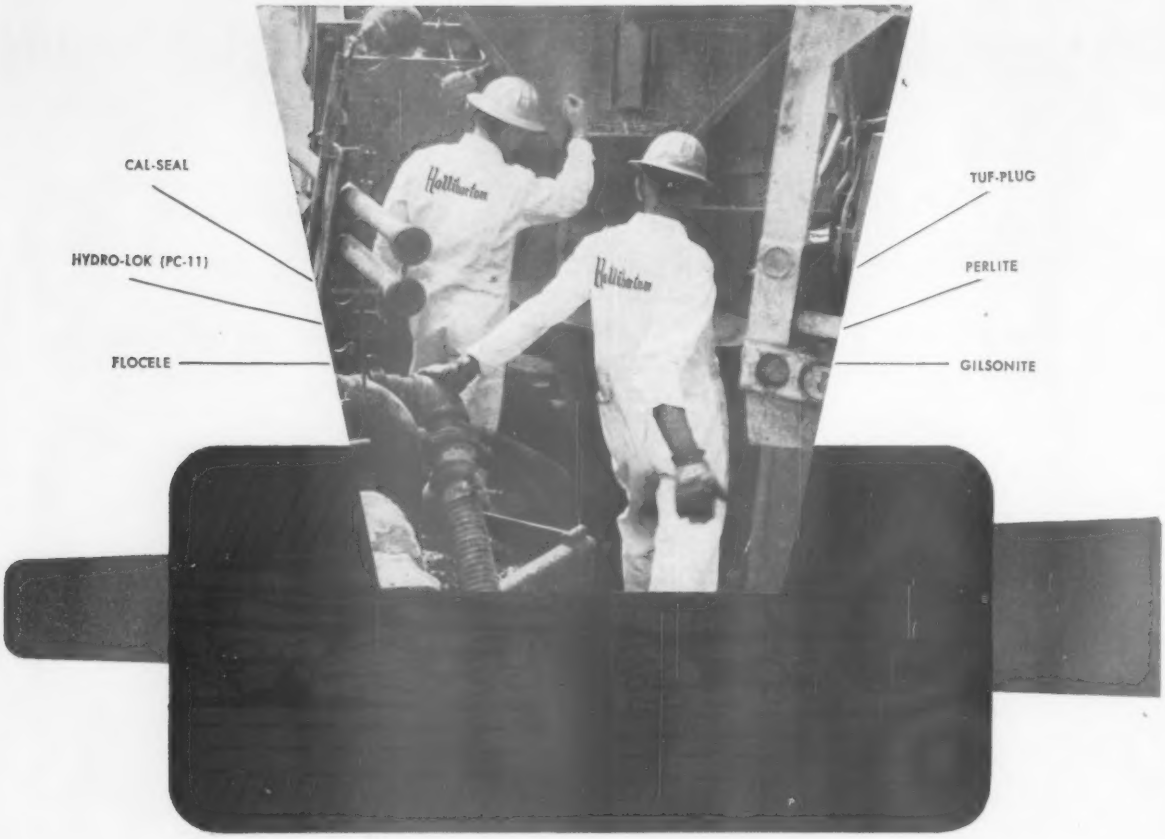

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When drilling through highly permeable formations, cavities, fissures or vugs, lost circulation is a common difficulty. If lost circulation is not remedied, it may jeopardize the success of the drilling operation. In any case, serious loss of rig time and greatly increased cost can result.

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At the first sign of lost circulation . . . consult Halliburton immediately. Your nearby Halliburton Representative will help save "profit-life" by rushing the proper remedies to the site.

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are used both as a blocking agent and as a fluid column lightener. Perlite is a lightweight mineral used in granular form as a cement additive. The two forms available — regular expanded perlite and a blend of this with unexpanded perlite — lower the weight of the slurry column and increase the slurry volume.

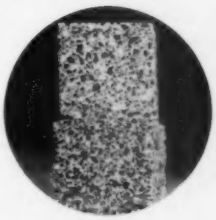
TUF-PLUG . . .

a high strength granular bridging agent for cement slurries which seals wide fractures more effectively than most fibrous materials. Tuf-Plug is effective alone or as good companion material used in conjunction with other flake or fibrous lost circulation materials, sealing extremely stubborn zones. The high mechanical strength of Tuf-Plug will support high columns of heavy cement slurries.

HALLIBURTON PRODUCTS AND MATERIALS
first aid for lost cirulation problems

CAL-SEAL with Portland Cement . . .

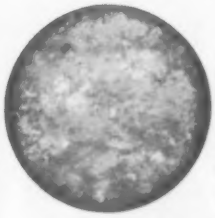
sets faster than either neat cement or Cal-Seal alone and is thus modified to seal off circulation loss zones at the lower temperatures commonly found at shallow depths.



GILSONITE . . .

a new granular light weight additive useable with any type of cementing composition for the reduction of slurry density and has superior lost circulation control characteristics. Is resistant to corrosion of waters or brines, resists attacks of acids or alkalies, has a high insulating value against electric currents.

. . . adds volume *not* weight to cement slurry (specific gravity of 1.07), resulting in light weight slurries having high compressive strength at low temperatures. Has been used successfully for high fill-up cementing, multiple stage cementing, plug back operations and setting production liners in gas wells with weak formations.



HALLIBURTON FLOCELE . . .

when added to cement slurries, effectively bridges and seals most fissures and other thief zones. It prevents or lessens loss into permeable formations during casing cementing. Flocele is chemically inert cellulose film flake which does not affect the pumping or setting properties of cements. Economical; usually 1% or less of Flocele is sufficient.

HYDRO-LOK (PC-11) . . .

is excellent for sealing off circulation loss zones in naturally fractured formations. It is a plastic slurry consisting of a resin mix and inert solid materials . . . can be pumped or used in a Dump Bailer for many lost circulation conditions. It forms a permanent seal and is not soluble in acids and well fluids.

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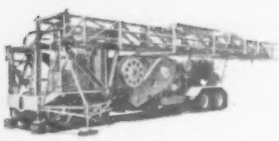
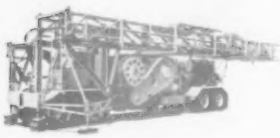
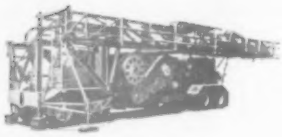


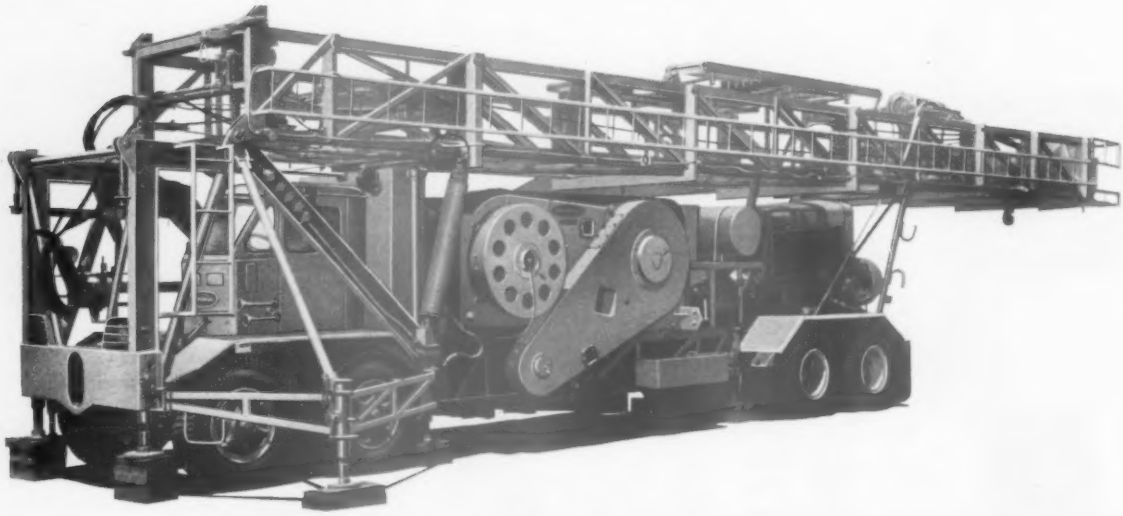
SERVICING



WORKOVER



COMPLETION



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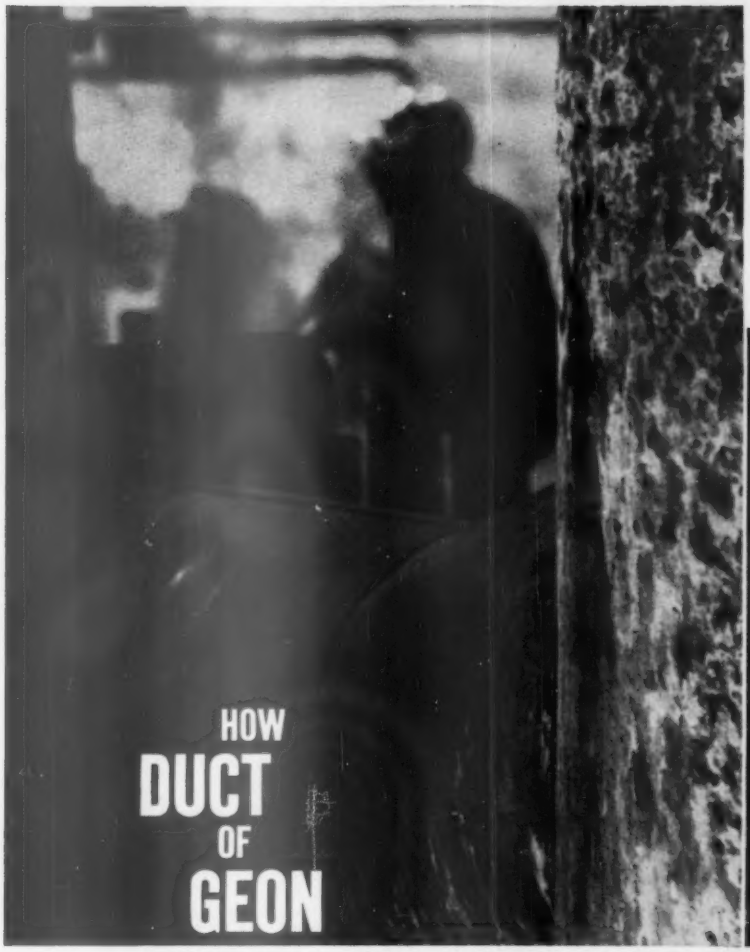
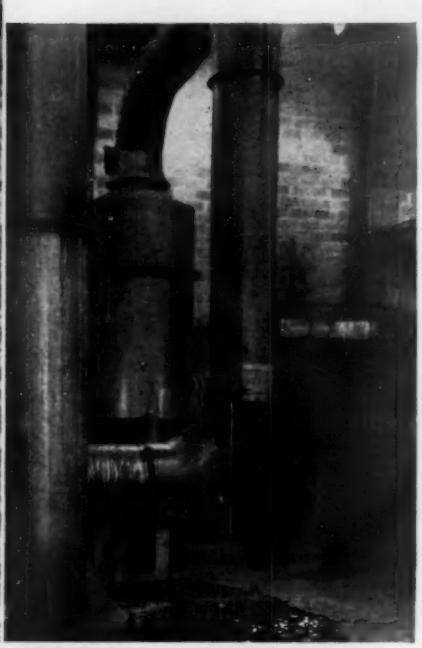


The large duct shown here was fabricated of Geon vinyl by Colonial Plastics Mfg. Co. through their distributor, Gould-Kramer, Inc., Cleveland, Ohio. B.F.Goodrich Chemical Company supplied the Geon vinyl.



CONQUERS CORROSION IN CHLORINATION ROOM

A tougher corrosion problem than this one would be hard to find. That's why all the large round duct you see is fabricated from rigid sheet made of Geon vinyl.

This room is where spent gases are carried from chlorinating operations to storage tanks. The atmosphere is such that personnel must wear goggles and face masks at all times. Corrosion would make short work of most ductwork or pipe.

But Geon is unaffected by acids, oils or many hydrocarbon chemicals. It is easy to fabricate, light in weight, and simple to install. Duct, pipe—even complete fans and valves—made of Geon are solving corrosion problems throughout industry.

For more information on products made of Geon vinyl—or on this versatile material itself—write Dept. GR-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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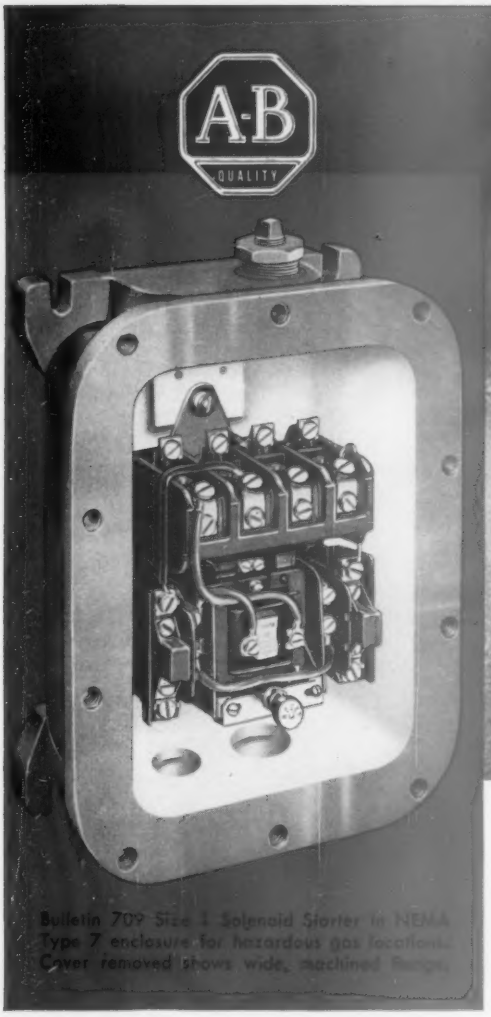
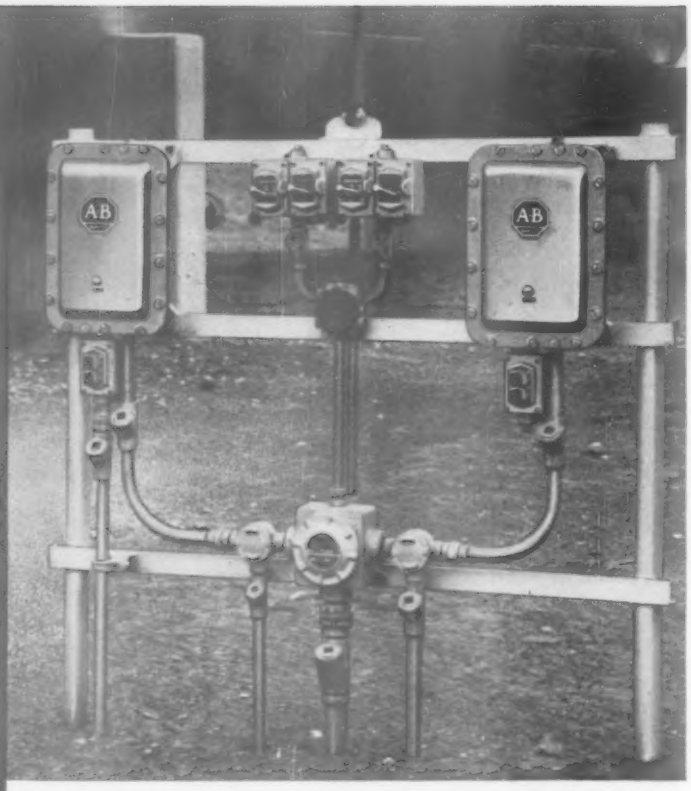


Bulletin 709 Size 1 Solenoid Starter in NEMA Type 7 enclosure for hazardous gas locations. Cover removed shows wide, machined flange.



Reduce Routine Inspections...

Save Time — Save Money with Allen-Bradley maintenance free starters

The fact that Allen-Bradley motor starters operate over long periods of time—without attention of any kind—is of great value in hazardous locations where inspection requires removing and replacing of bolted enclosures.

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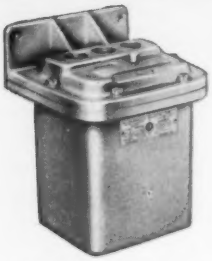
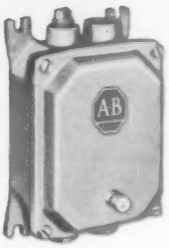
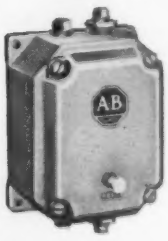
Allen-Bradley Co., 1304 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



NEMA 8
Corrosive
Hazardous Gas



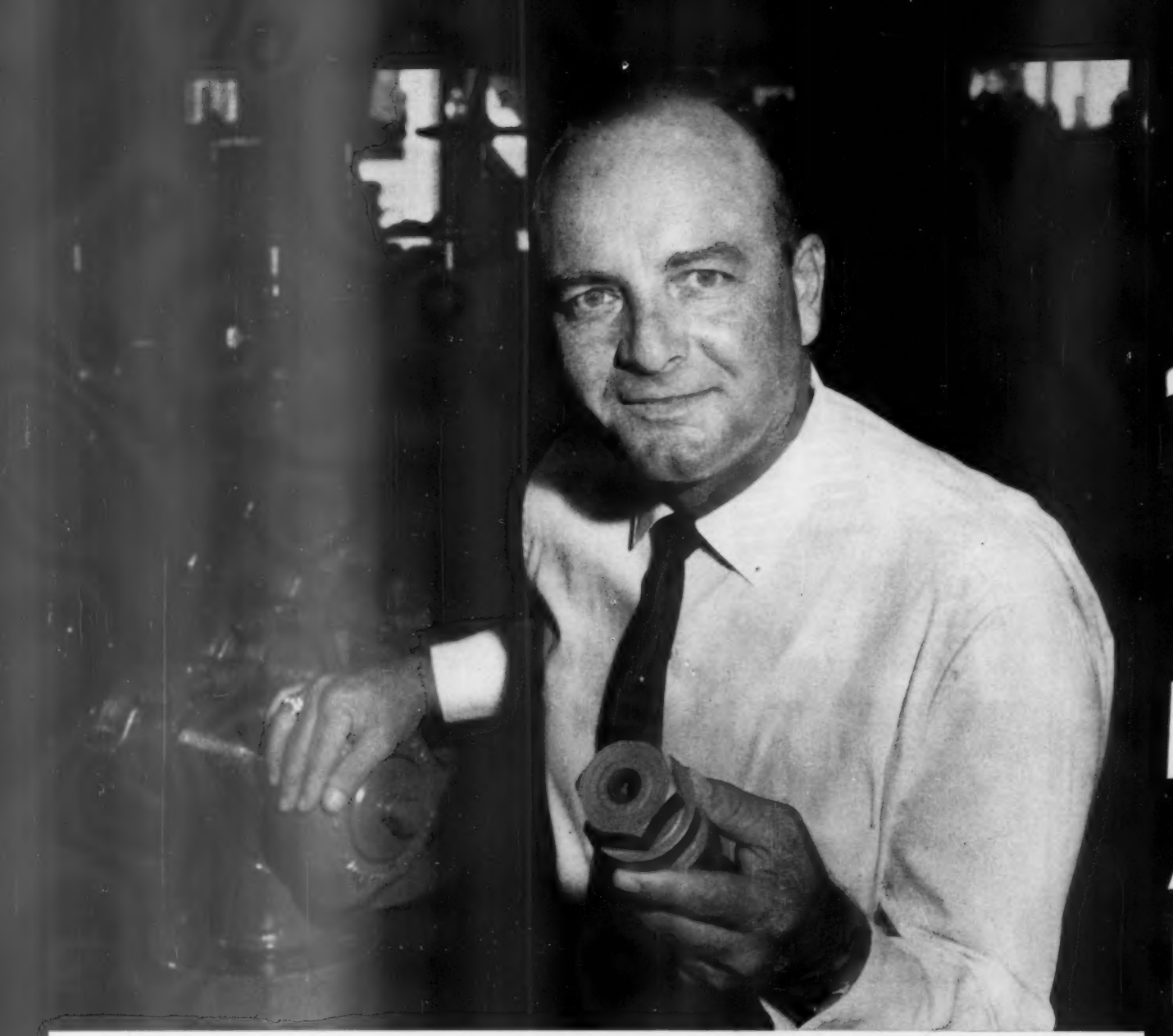
NEMA 4
Watertight
Weatherproof



NEMA 9
Hazardous
Dust Locations

NEMA 11
Corrosive
Gas Locations

ALLEN-BRADLEY
Member of NEMA
Quality Motor Control



This bean lasts for the flowing life of a well!

Low cost, renewable inserts take the cutting action

With ordinary care, a single UNIBOLT Master Bean will last for the entire flowing life of a well. These beans are threaded to receive an inexpensive screw insert. The cutting action of sand-laden production is imposed on the expendable insert, not the master bean.

The inserts are not only inexpensive, they are easier to change than regular beans. Drilled in increments of 5% and 10% of well flow, as well as in increments of 1/64th inch, these inserts provide the versatile range of an adjustable choke with the fine accuracy of a positive orifice.

This is only one of a number of refinements in flow bean design perfected and introduced by UNIBOLT. Others are: shaped entrance to reduce turbulence and maintain flow accuracy, "flow-rating" as a standard inspection procedure to insure correct orifice sizing, and special analysis alloys and heat-treatments for corrosion and wear resistance.

UNIBOLT flow beans are designed to fit only UNIBOLT Positive Choke Bodies and Cage Nipples.

Request UNIBOLT Positive Choke Bodies and Cage Nipples from your Christmas tree supplier and be assured of the finest in dependable flow control.

Uniholt screw inserts are easy to change, and they protect the master bean against cutting.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

cost-cutting gas boosters

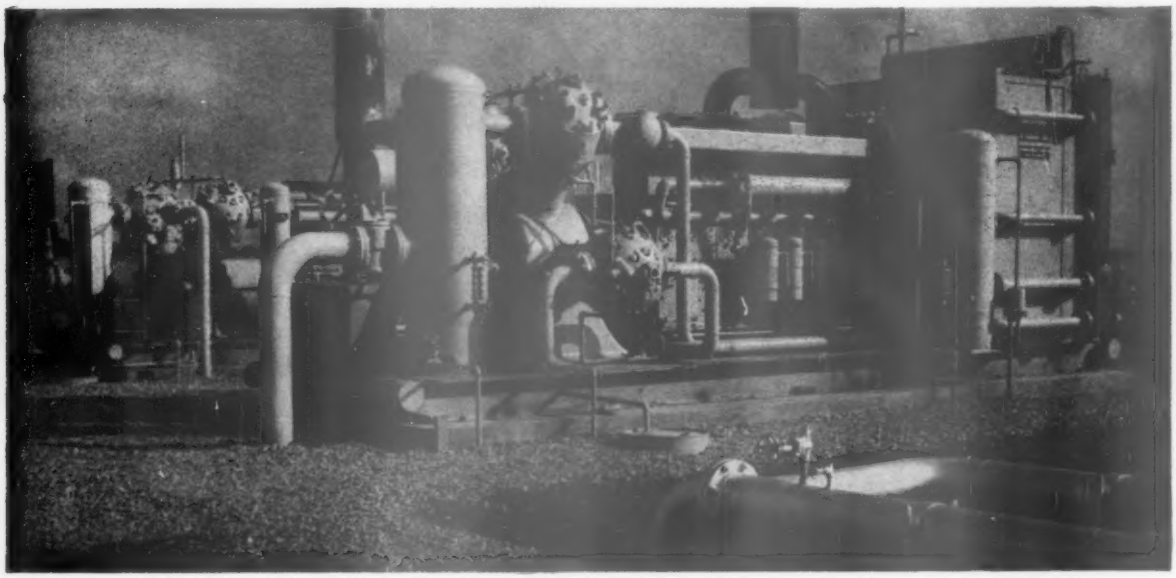
In a recent 12-month period, Sunray Mid-Continent Oil Company installed 11 "packaged" gas compressors, each dependably powered by a White Superior gas engine. Every day 4050 HP from the Superiors drives compressors that deliver 37,475,000 cubic feet of gas for Sunray's expanding gathering program!

Throughout gas and oil fields, rugged, compact Superior engines are proving economical, both in purchase price and operating costs. For example, because of the ability of Superior engines to deliver required HP at low speeds, the engines are directly coupled in engine-compressor packages. This eliminates the need for expensive gear reducers, results in smooth continuous performance and low fuel consumption.

Superiors' extreme design simplicity, precision construction and many advanced engineering refinements reduce maintenance and repair and greatly prolong engine life.

Superior engines are available in diesel, dual-fuel and gas engines from 190 to 2150 HP and in portable or stationary generator sets from 150 to 1500 KW. Get complete information from leading oil field distributors, White oil field representatives, or through White Diesel Engine Division.

Sunray Mid-Continent expansion program includes 11 new Superior-powered compressors

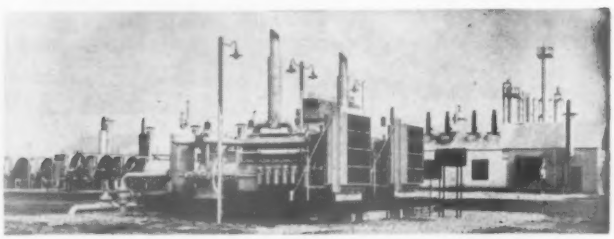


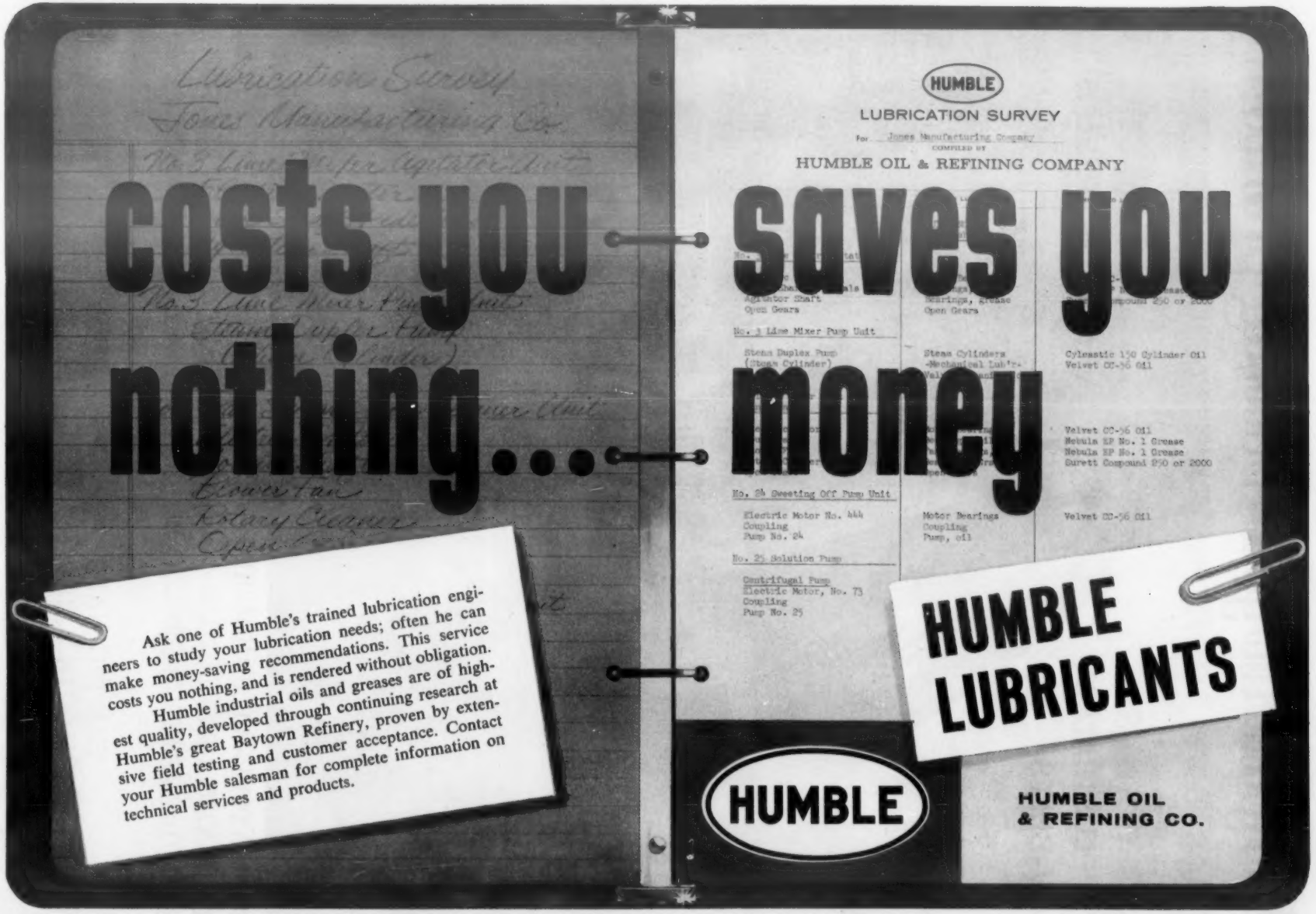
Superior ENGINES · ATLAS Imperial DIESEL ENGINES · White DIESEL

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY
Plant and General Offices: Springfield, Ohio

Superior 8G-825 eight-cylinder gas engines driving gas boosters at Sunray's West Moore Field, Cleveland County, Oklahoma.

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saves you money
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LUBRICATION SURVEY
For Jones Manufacturing Company
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HUMBLE OIL & REFINING COMPANY
No. 1 Line Mixer Pump Unit
Steam Duplex Pump (Steam Cylinder)
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Cylesstic 150 Cylinder Oil
Velvet GC-56 Oil
Velvet GC-56 Oil
Nebula EP No. 1 Grease
Nebula EP No. 1 Grease
Gurett Compound 250 or 2000
No. 24 Sweeting Off Pump Unit
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Coupling
Pump No. 24
Motor Bearings
Coupling
Pump, oil
Velvet GC-56 Oil
No. 25 Solution Pump
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Pump No. 25
Ask one of Humble's trained lubrication engineers to study your lubrication needs; often he can make money-saving recommendations. This service costs you nothing, and is rendered without obligation.
Humble industrial oils and greases are of highest quality, developed through continuing research at Humble's great Baytown Refinery, proven by extensive field testing and customer acceptance. Contact your Humble salesman for complete information on technical services and products.
HUMBLE LUBRICANTS
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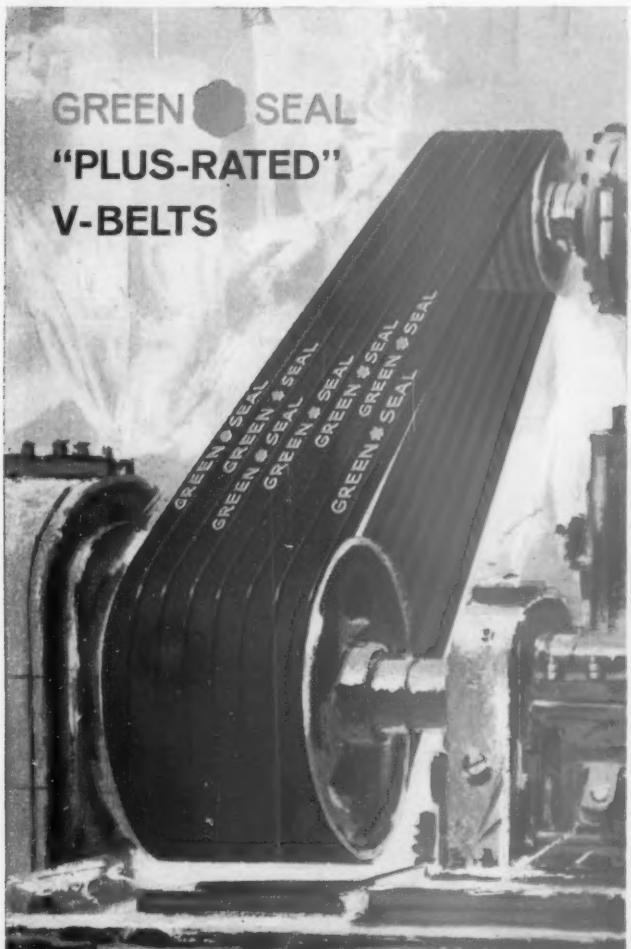
HUMBLE OIL & REFINING CO.

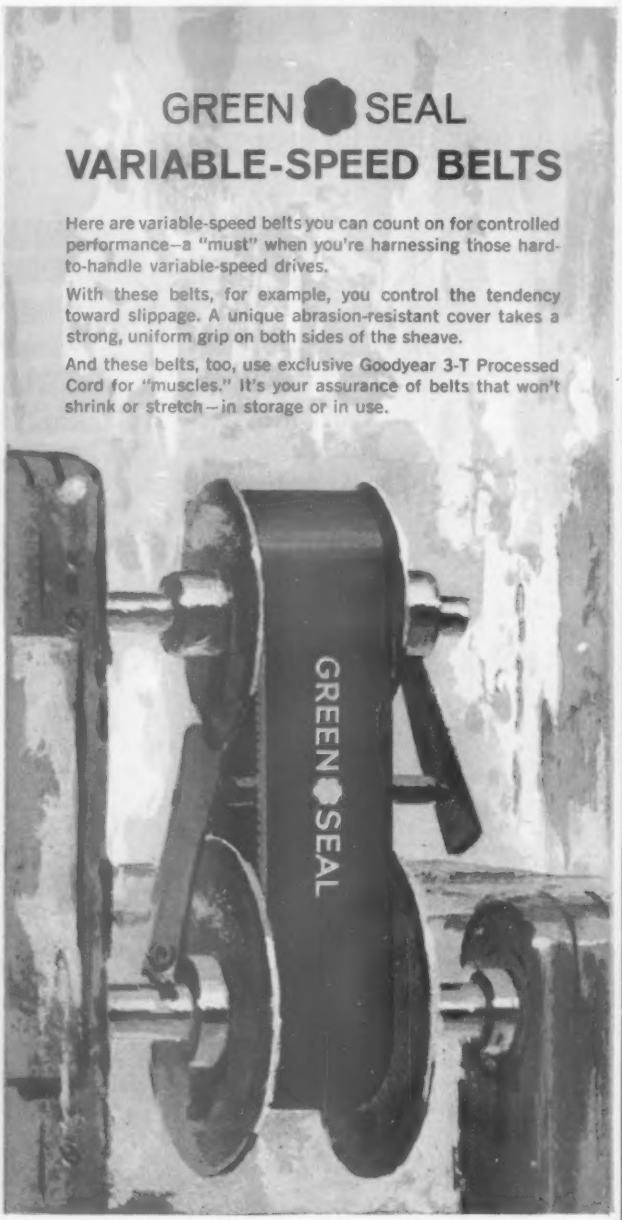
to beat all your belting problems...



Team-matched Green Seal V-Belts—now "plus-rated" to give you top horsepower-hours per dollar – always pull together perfectly—whether a drive uses 2 or 50 belts.

Secret is their complete dimensional stability – built-in through unique tension members of airplane-type steel cable or exclusive Goodyear 3-T treated Cord.

These belts stay dimensionally stable, too – no matter how long you store them. That's a big factor when it comes to stocking stand-by belts for emergency use.



Here are variable-speed belts you can count on for controlled performance—a "must" when you're harnessing those hard-to-handle variable-speed drives.

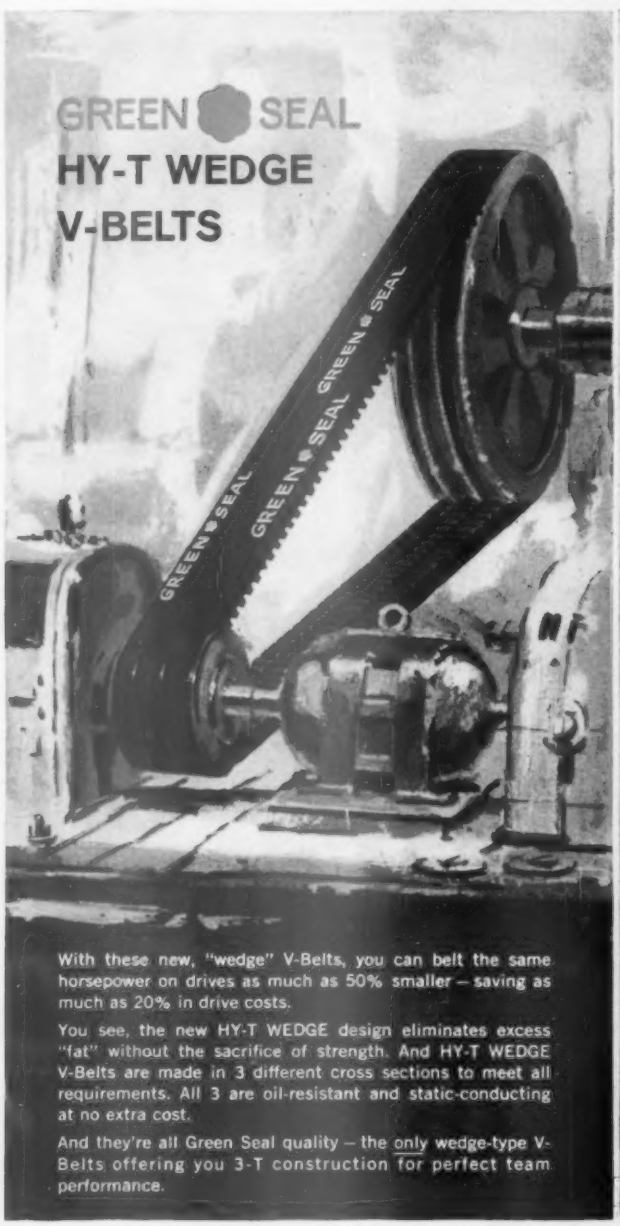
With these belts, for example, you control the tendency toward slippage. A unique abrasion-resistant cover takes a strong, uniform grip on both sides of the sheave.

And these belts, too, use exclusive Goodyear 3-T Processed Cord for "muscles." It's your assurance of belts that won't shrink or stretch – in storage or in use.

NO MATTER WHAT YOU'RE BELTING–OR WHAT TYPE BELT IT CALLS FOR–YOU CAN COUNT ON A GOODYEAR BELT FOR MAXIMUM, TROUBLE-FREE HOURS AT MINIMUM COST. JUST CONTACT THE

THE BIG NAME IN V-BELTS: **GOODYEAR**

go down the line with Goodyear



With these new, "wedge" V-Belts, you can belt the same horsepower on drives as much as 50% smaller – saving as much as 20% in drive costs.

You see, the new HY-T WEDGE design eliminates excess "fat" without the sacrifice of strength. And HY-T WEDGE V-Belts are made in 3 different cross sections to meet all requirements. All 3 are oil-resistant and static-conducting at no extra cost.

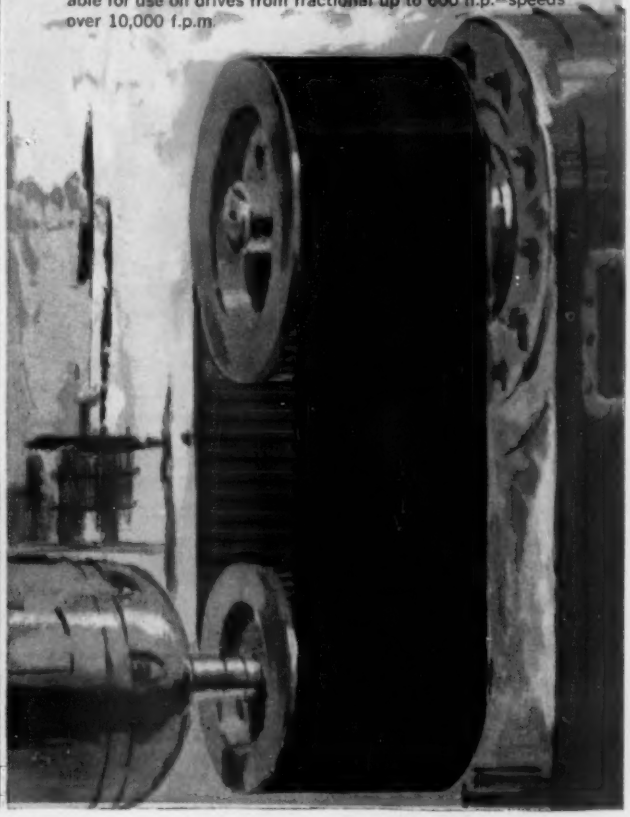
And they're all Green Seal quality – the only wedge-type V-Belts offering you 3-T construction for perfect team performance.

POSITIVE DRIVE BELTS

The new P.D. Belts by Goodyear are made to order for the belt-killing drives – the ones operating under high torque and at precise speed ratios.

P.D. Belts open the door to many design advances: smaller drive sizes, lighter weight, greater precision. Moreover, maintenance needs can be cut – lubrication systems completely eliminated.

What's more, super-quality P.D. Belts by Goodyear are available for use on drives from fractional up to 600 h.p.–speeds over 10,000 f.p.m.



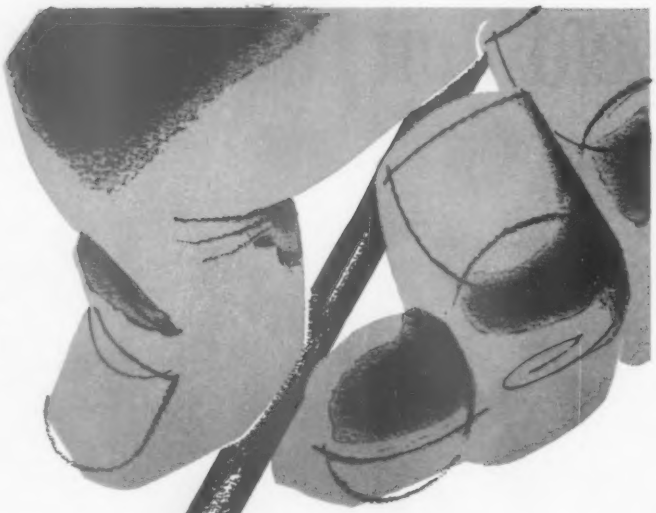
G.T.M.–GOODYEAR TECHNICAL MAN–THROUGH YOUR GOODYEAR DISTRIBUTOR. OR WRITE: GOODYEAR, INDUSTRIAL PRODUCTS DIVISION, LINCOLN 2, NEBRASKA, OR AKRON 16, OHIO.

YEAR

THE GREATEST NAME IN RUBBER

Green Seal, HY-T WEDGE, P.D.–T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

IF YOU USE VALVES



YOU NEED THIS CATALOG!

Kerotest has been producing highest quality valves for the past 50 years for customers all over the world. Our new catalog—just off the press—gives dimensions, specifications and working tables to help you specify the right valves for refinery, industrial and marine applications.

Send for your copy—today!

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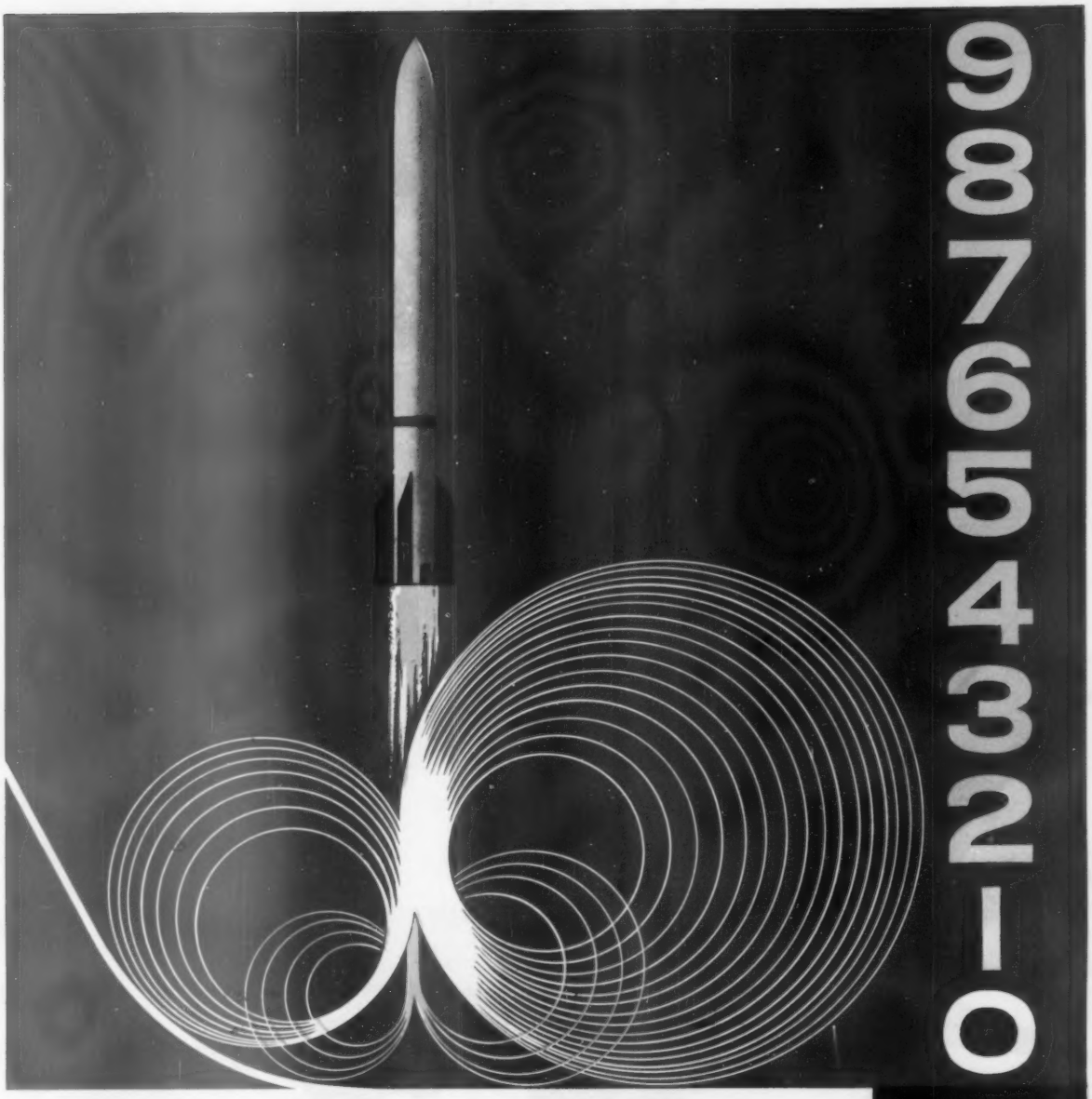

hot countdown . . . cool blastoff

sophisticated piping systems use BONNEY SWEEPOLETS for branch connections

Bonney Sweepolets are in use on the Saturn missile launching pad on the high velocity water cooling system of the blast deflector. The long sweep of the Sweepolet provides maximum fluid flow and its sophisticated design provides optimum stress distribution. For all piping systems involving unusual or complex stresses at branch connections, you will be wise to specify Bonney Sweepolets. Write for catalog S-1A.

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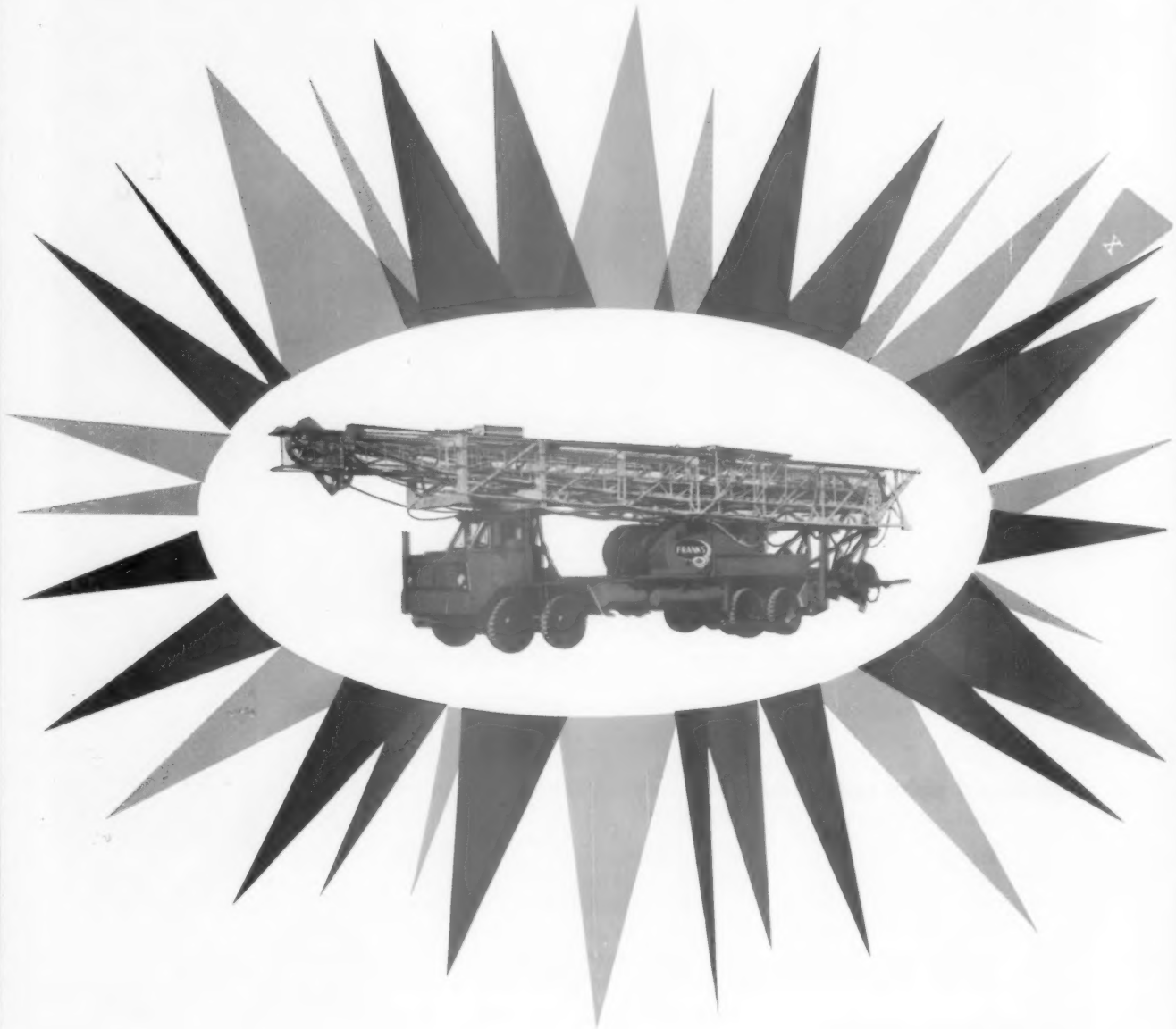
FRANKS

EXPLORER

Rocket



WORTH MORE WHEN YOU BUY IT!
WORTH MORE WHEN YOU TRADE IT!

Common sense will tell you that there **is** a difference in most things despite the tendency to imitate the leader. There's a difference in baseball players . . . in cooks . . . yes, even in oil-well servicing units . . . although competitive units are getting to look mighty like the Franks Explorer.

Now, this **difference** is what keeps the Franks Explorer ahead of the pack. It's the difference which makes superintendents prefer Franks units on their jobs. It's the difference you feel in your pocketbook when you trade it in. The higher resale value of Franks Explorers speaks louder of this difference than any words we can dream up.

Ask the man who uses Franks!

"WORTH MORE" FEATURES

- Industrial high torque power with plenty of reserve
- Rugged duty drums . . . flanges won't spread
- Safety-view controls
- Complete package service on entire unit
- True rated capacity derricks . . . 100,000 to 275,000#
- No sag . . . no bend frame
- Safe front and rear rocker beam axle suspension
- Service proven hydratarder brakes with patented derrick tank to give maximum cooling for deepest wells
- More usable power

ON THE SPOT . . . 'ROUND THE CLOCK . . . FIELD SERVICE

And, Franks Unexcelled Factory Service the World Over Makes the Franks Explorer Worth More While You Have It!

WELL SERVICING AND DRILLING UNITS
FRANKS
DIVISION OF
CABOT
PAMPA, TEXAS

. . . manufacturers of the most imitated units in the field today!

Let Pipe Line Service carry that load!

Coating and wrapping facilities located near major pipe-producing areas provide buying flexibility, uniform protection

Because PLS plants with their vast storage areas are so strategically located, your pipe buying procedure can be greatly simplified . . . a load of detail lifted off your shoulders. You order from the desired pipe mill, specify delivery to the PLS plant serving the area, and we take it from there! There's always room at our 150 acres of plant sites to store your pipe until the exact time of need. Pipe can be released for processing and be on its way to the project in a matter of a few days. Savings in time often add up to weeks when plant-applied coatings are specified. Delivery of PLS coated and wrapped pipe is assured WHEN you want it, where you need it. So, let PLS carry that load for you. Call our nearest representative and get all the details.

Sales offices at all plant locations... and Atlanta, Georgia; Houston, Texas; Lincoln, Nebraska; Syracuse, New York; and Dallas, Texas

PIPE LINE SERVICE CORP. SERVICE EQUIPMENT MATERIALS FRANKLIN PARK, ILL.

Pipe Line Service Corporation

FRANKLIN PARK, ILLINOIS

Quality pioneers in coating and wrapping pipe for over a quarter century

A SUBSIDIARY OF AMERICAN STEEL FOUNDRIES

Specially designed for rugged oil field duty

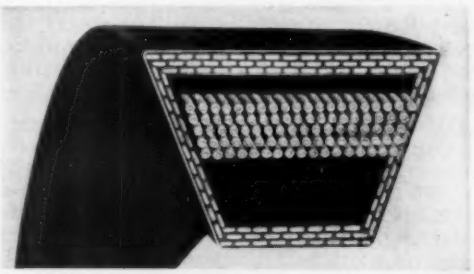
New Dayton BLUE-RIBBON® V-Belts

The New Blue Ribbon Thorobred V-Belt is not just a redesigned belt, but a totally new approach to V-Belt construction . . . new materials, new design, new specifications. It is a sturdy and powerful V-Belt, specially designed for the oil industry, that can withstand rugged, heavy duty service for a long time . . . with no "time-outs."

Check these outstanding features

- **Now, Blue Ribbon V-Belt** horsepower ratings are increased 40% over previous standard belts. Load carrying capacity is doubled. New super-strength, synthetic cords absorb machine killing shock loads and vibration . . . protect machinery . . . prolong belt life.

- **Extreme length stability** and precise manufacturing mean that belts can now be ordered in perfectly matched sets. Thus each belt pulls its share of the load increasing drive performance and bearing life.



Blue Ribbon Thorobred V-Belts are available in A through E cross-section industry standard sizes.

Find out how Blue Ribbon Thorobreds can increase your profit per job, write today to:

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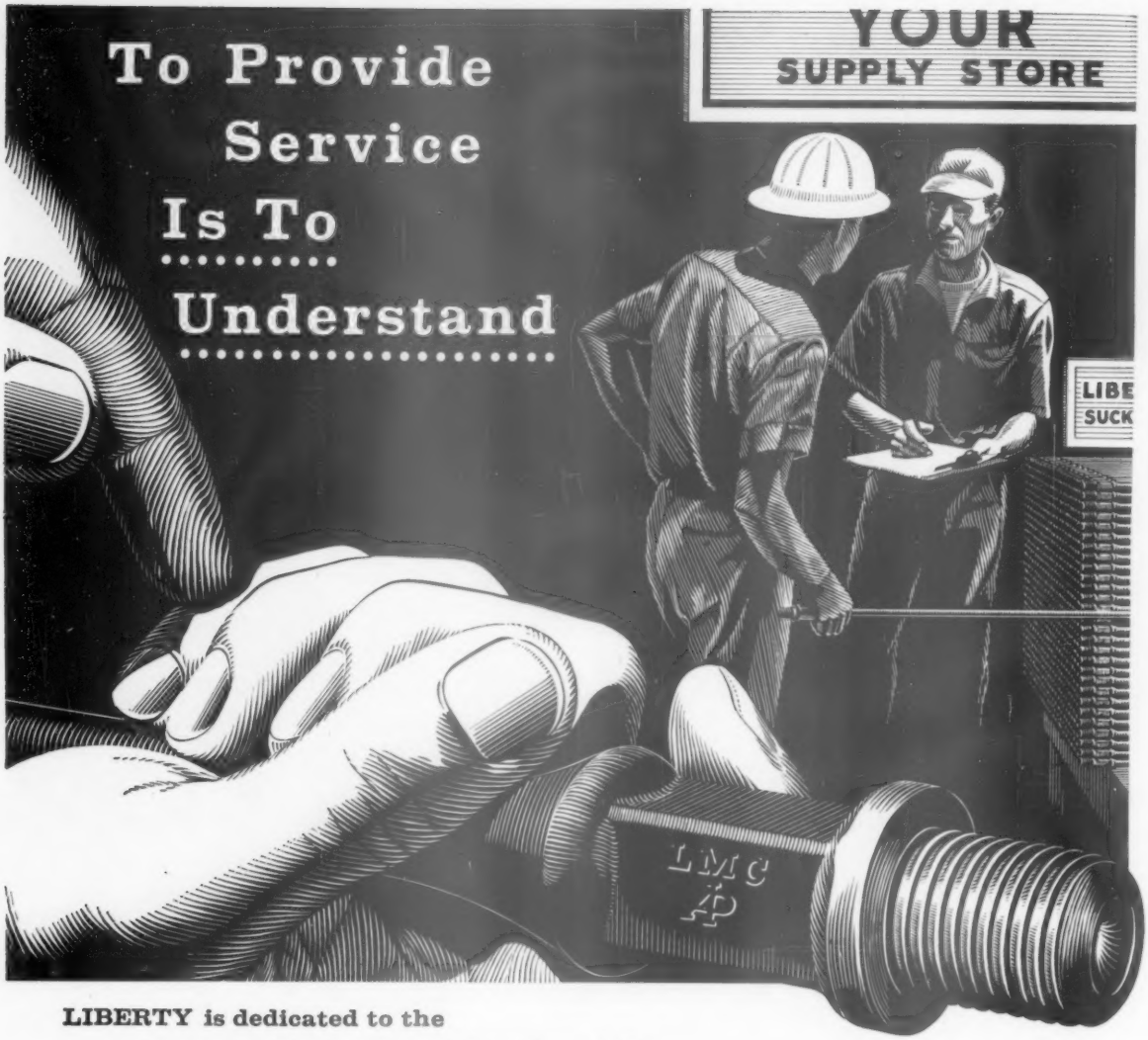
Dayton Industrial Products Co.

2001 Janice Avenue Melrose Park, Illinois

A Division of The Dayton Rubber Co.



LIBERTY is dedicated to the understanding and consideration of the problems of both Supply Stores and Producers.

LIBERTY has worked closely with the petroleum production industry for over 40 years to produce fine sucker rods and pumping units for a rapidly advancing petroleum technology.

LIBERTY is proud of its contribution to the never-ending quest to reduce the cost of producing oil. The LIBERTY ½" SUCKER ROD, latest product of LIBERTY technology, has been met with approval by Producers everywhere and is in widespread use in slim-hole and dual-completions. Early results indicate that more well completions will now be possible because of savings from 30 to 60% on each well utilizing slim-hole pumping equipment. This in turn means increased business for the many dedicated and friendly Supply Stores through which all LIBERTY products are sold.

LIBERTY subscribes to the belief that what is best for Producers will be best for Supply Stores and Equipment Manufacturers.

**FOR EXCELLENT PRODUCTS AND SERVICE,
SPECIFY LIBERTY SUCKER RODS AND PUMPING UNITS.**

ENGINEERED EXCELLENCE

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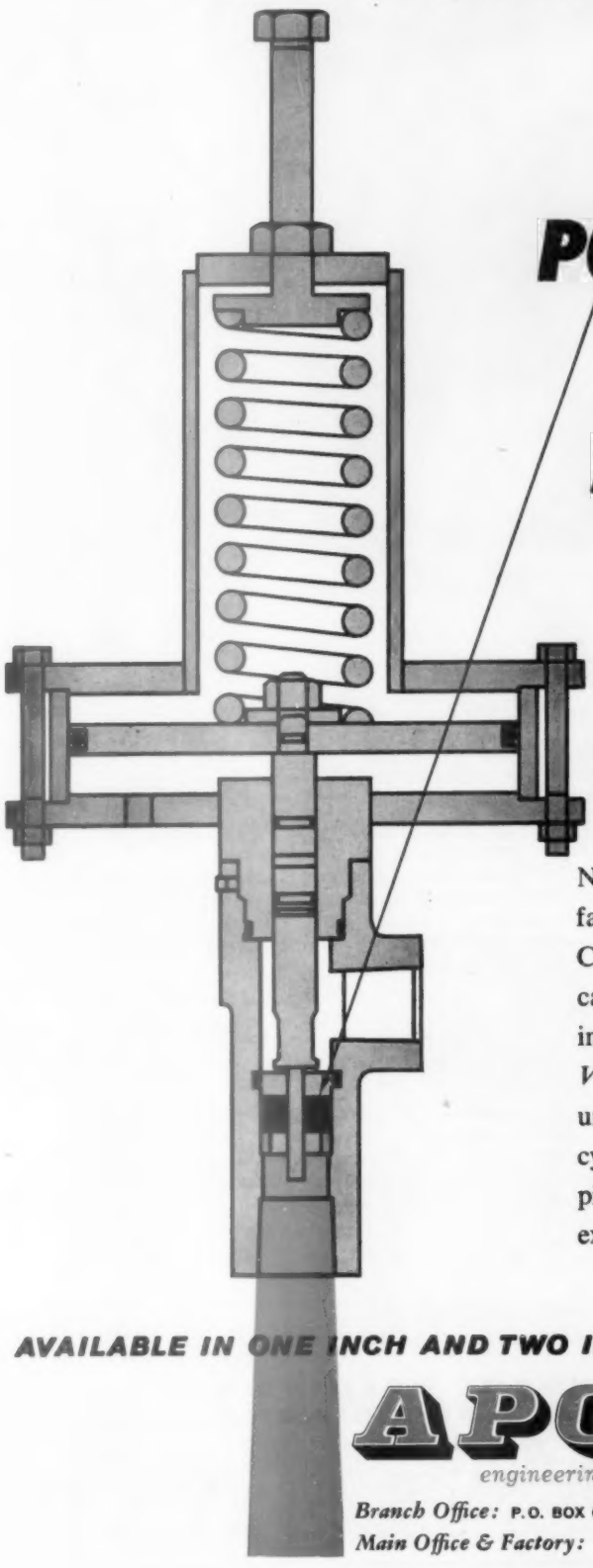
Here's a liquid dump valve with...



POSITIVE SHUT OFF *that* STOPS LEAKAGE

The Check-Stream DUMP VALVE

Now you can stop leakage, the major cause of failure in conventional dump valves, with the new Check-Stream Dump Valve. Even the smallest leak can cause an erosive action that can ruin your valve in a very short time. *The Check-Stream Dump Valve gives positive shut off* . . . it will not leak even under the most severe conditions. A solid rubber cylinder, expanded against the body liner by a piston motor, provides positive shut off as well as extremely fine throttling action.

AVAILABLE IN ONE INCH AND TWO INCH SIZES

Write today for Bulletin 25 giving complete specifications on the Check-Stream Dump Valve.

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Experienced Yuba-Southwest Crews erect these famous oil tanks—anywhere

Get acquainted with all the features of famous Yuba Southwest Floating Roof Tanks. Full description is contained in Bulletin No. FRT 59-1, yours on request.

Refineries throughout the country are now served through the experienced engineering staff, extensive fabricating facilities, and responsible field erection crews of Yuba Southwest—*operating nationwide.*

This major expansion in sales, service and erection of famous Southwest Floating Roof Tanks has been brought about through Yuba's program of planned diversification and integration of the last several years. It has greatly broadened Yuba's scope of activity and geographical service area in this highly specialized field.

Before you plan your next tank installation, get in touch with Yuba. See how the capabilities of this organization can be of real help to you in the most profitable solution to all your tank problems—all the way from design to erection.

Other Southwest products for the petroleum industry include columns of various types, reactors, regenerators, vacuum towers, catalytic reforming towers, catalytic reforming units, high pressure vessels, kilns, retorts and "Dewar-type" vessels.

specialists in fabrication and erection of processing and storage equipment

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3201 West Mission Road, Alhambra, Calif.

YUBA CONSOLIDATED INDUSTRIES, INC.

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Here's Why Oil Men Specify
EC&M HIGH VOLTAGE STARTERS

2200-4800 Volts
Totally Oil-Immersed

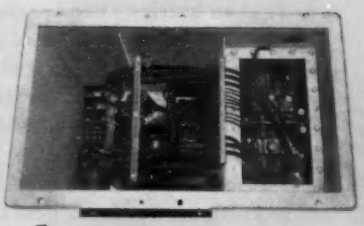
EC&M Type ZHS Starters at Southwestern pipe line trunk station

Designed for Easier Installation, Inspection and Maintenance

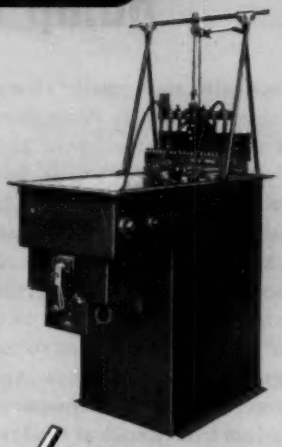
Specifically designed for Class I, Group D, Division 2, semi-hazardous locations . . . NEMA 3R (raintight enclosure). 50,000 KVA interrupting capacity.

***Fast* installation** because starters are shipped with all internal wiring complete. All leads are of anti-syphon construction.

Easy inspection • Contactor and overload relay panel may be raised, as one unit, above oil level. No disconnecting of bolts or leads. *(See lifting mechanism at extreme right.)* Safer, too . . . note view windows on each side of load-break disconnect switch.



View from above shows complete internal wiring . . . anti-syphon leads. These "ready-to-use" starters are complete with control transformer for 220 volt push button operation.



EC&M Contactor lifter raises contactor and overload relay above oil level for easy inspection. No bolts or leads to disconnect.

For literature describing EC&M's complete starter line, write for Bulletin 8131-T

SQUARE D COMPANY

EC&M DIVISION • CLEVELAND 28, OHIO

wherever electricity is distributed and controlled

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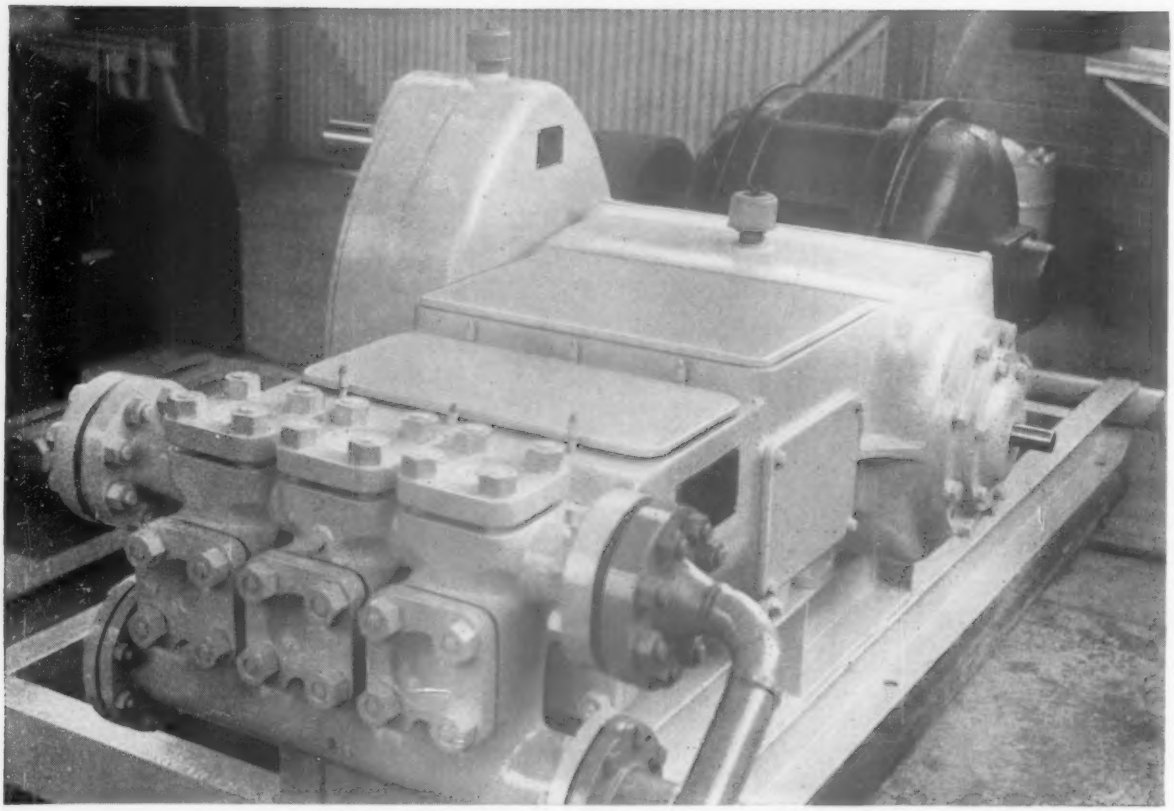

Timken® double-row tapered roller bearings keep pump working without watching

IT practically runs itself. That's why this new Triplex Pump does so well on toughest oil field and industrial pumping jobs. It has larger shaft diameters, crossheads and busings than any in its class. And to keep it running at full load continuously without watching, the crankshaft is mounted on two Timken® double-row tapered roller bearings. The two-row bearings allow precise clearance adjustment and freedom from knock at load reversals. So many machine builders use Timken bearings because they:

1) *Keep shafts positively aligned . . .* minimize deflections and end play. And Timken bearings are *tapered* to take any combination of radial and thrust loads.

2) *Deliver more for the money.* Better engineering service from graduate *engineer* salesmen; greater bearing service because of unmatched research and testing facilities; higher quality because we use the highest bearing-quality alloy steel available.

For better machines, be sure the ones you build or buy are Timken bearing-equipped. ***When you buy Timken bearings you get . . .*** *1) Quality you can take for granted. 2) Service you can't get anywhere else. 3) The best-known name in bearings. 4) The pace setter in lower bearing costs.* The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

BETTER-NESS rolls on

TIMKEN®

tapered roller bearings

SAVE 4 WAYS WITH LIGHTWALL

ELECTRIC
RESISTANCE-WELD
LINE PIPE

Because Southwestern LIGHTWALL greatly reduces weight without sacrificing performance . . . it is today's biggest value for your pipeline dollar. Southwestern LIGHTWALL Electric Resistance-Weld Line Pipe offers the same or greater tensile strengths and working pressures of standard weight pipe of the same I.D. That's why you save four ways with LIGHTWALL.

Southwestern's manufacturing flexibility and large inventories of selected steel coils assure you of prompt deliveries.

CHECK THESE DOLLAR SAVINGS IN

- √ *initial cost*
- √ *transportation*
- √ *installation*
- √ *long trouble-free service*

. . . available in a wide range of wall thicknesses to .188" wall, from 1.315" O.D. to 4.500" O.D.

SOUTHWESTERN PIPE, INC.*

*Corporate name changed from Southern Sales & Transportation Co, May 1st, 1959

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CUT COSTS from TRAILER to TRENCH

with a John Deere 300 Sideboom

Sideboom operation is all-hydraulic: line winch and boom winch are powered by hydraulic controls; hydraulics operate counterweight and provide two-way cable "hold."

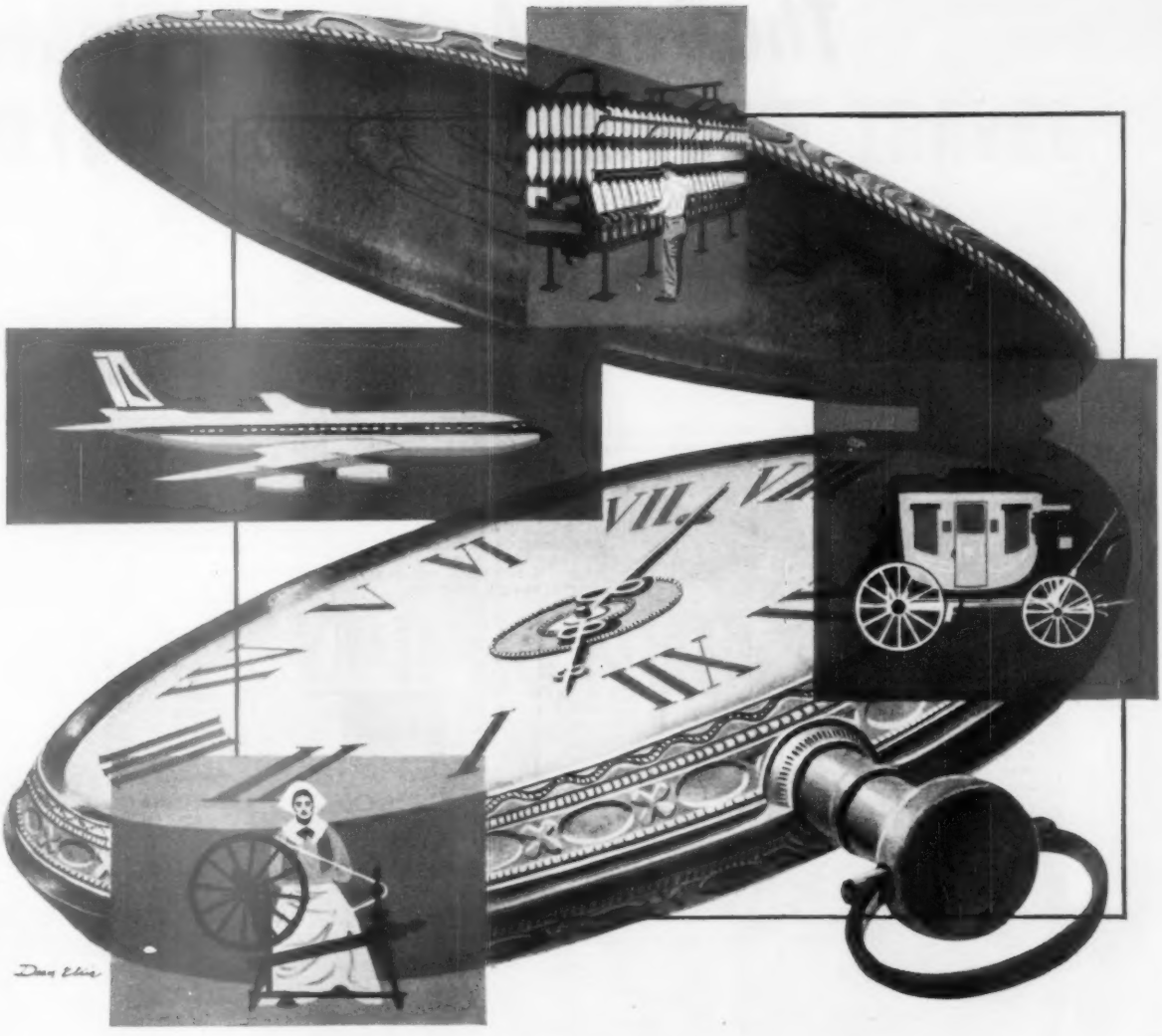
The low-cost, compact John Deere 300 Crawler Sideboom really speeds construction of gathering systems and gas lines. Only 84 inches in width, this highly maneuverable crawler outfit boasts a lifting capacity of 4000 pounds at four feet from boom pivot. It handles pipe smoothly and positively—and with simple attachment bends pipe up to eight inches in diameter. The unit's 78-inch blade backfills neatly and in a hurry.

You can select from gasoline- or Diesel-power on tracks or wheels. Easy operation is assured through new John Deere Pilot Touch single-stick "440" Crawler control or Advanced Power Steering in "440" Wheel Tractors.

Parts and service available in cities coast to coast. See your classified telephone directory or write today.

JOHN DEERE
INDUSTRIAL DIVISION
3300 River Drive, Dept. 2652
MOLINE, ILLINOIS

JOHN DEERE *"Specialists in Low-Cost Power with a Heavyweight Punch"*



what's an hour worth?

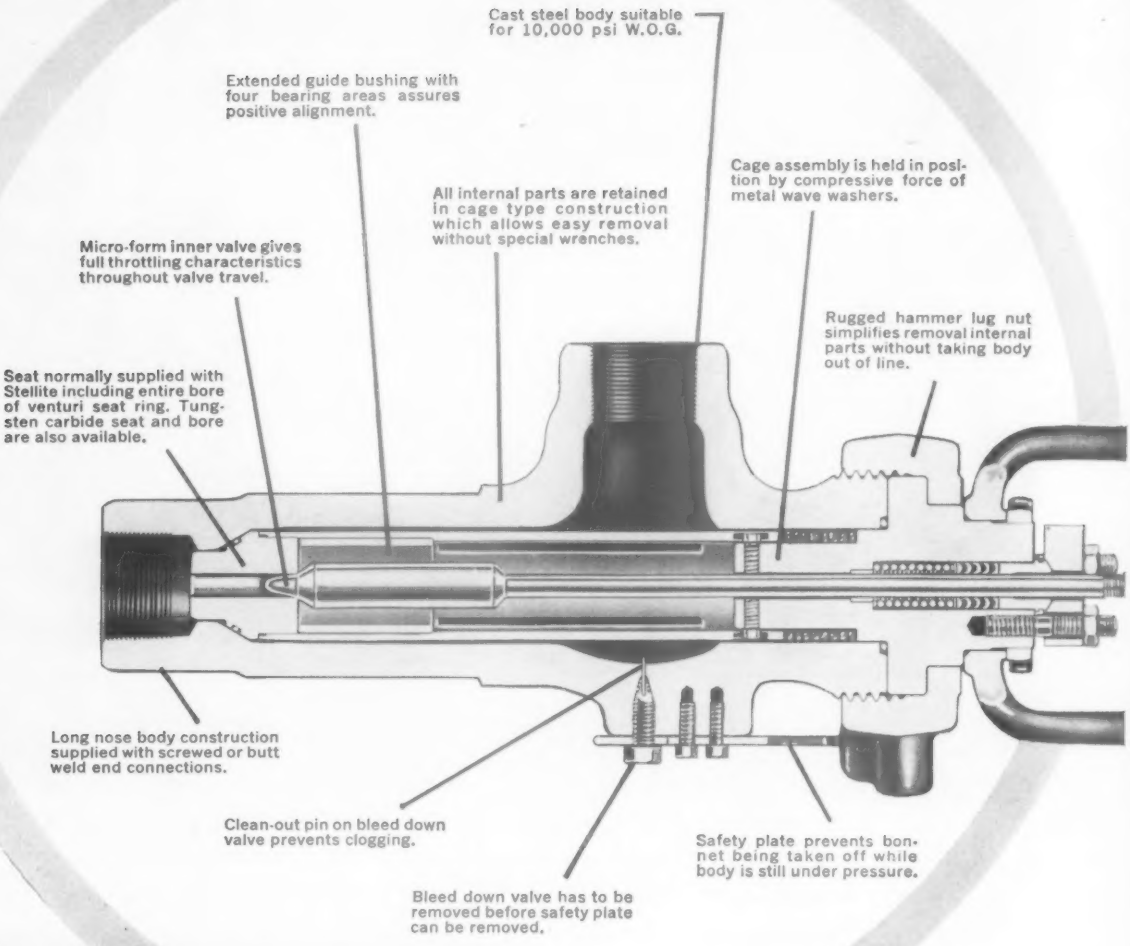
In terms of time an hour is always 60 minutes. Today's hour, however, is worth more than any in our history. Fuel energy, most of it supplied by natural gas and oil, makes the difference. By activating the wheels and pistons of our industrial machine, energy increases both production and leisure . . . frees labor of drudgery . . . speeds and spurs the flow of goods and people. Our growing nation will demand more and more low cost, man-saving energy. Tennessee Gas, active in every phase of gas and oil, will supply an increasing share of the fuel and by-products that make every hour more enjoyable.

From natural gas and oil . . . heat, power, petrochemicals that mean ever wider service to man.

TENNESSEE GAS TRANSMISSION COMPANY
HOUSTON, TEXAS

DIVISIONS: Tennessee Gas Pipeline Company · Tennessee Gas and Oil Company · Bay Petroleum Company
SUBSIDIARIES: Midwestern Gas Transmission Company · East Tennessee Natural Gas Company
Tennessee Life Insurance Company · AFFILIATE: Petro-Tex Chemical Corporation

The Only Automatic Heater
PROVIDES FULL THROTTLING


Cast steel body suitable for 10,000 psi W.O.G.
Extended guide bushing with four bearing areas assures positive alignment.
All internal parts are retained in cage type construction which allows easy removal without special wrenches.
Cage assembly is held in position by compressive force of metal wave washers.
Micro-form inner valve gives full throttling characteristics throughout valve travel.
Rugged hammer lug nut simplifies removal internal parts without taking body out of line.
Seat normally supplied with Stellite including entire bore of venturi seat ring. Tungsten carbide seat and bore are also available.
Long nose body construction supplied with screwed or butt weld end connections.
Clean-out pin on bleed down valve prevents clogging.
Safety plate prevents bonnet being taken off while body is still under pressure.
Bleed down valve has to be removed before safety plate can be removed.

MANUALLY OPERATED
TYPE 1012-HC

Type 1012-HC Manual Choke Body has all features of automatic model illustrated, except the conventional taper plug type inner valve is supplied. Only a new inner valve, bonnet and topwork are necessary for field conversion from manual to automatic operation.

Choke Valve That
CONTROL THROUGHOUT VALVE TRAVEL

The exclusive Fisher micro-form design plus precision machining of its inner valve, provides the Type 667-HC Heater-Choke with pressure and flow control characteristics never before offered to the petroleum industry. Here, at last, is a heater-choke that actually provides full throttling control throughout its entire valve travel.

In addition, the angle body design incorporates an extra-long outlet section with a smooth, machined outside diameter. Thus, the control valve can be mounted directly in the heater.

The valve body itself is made of steel with 2″ female NPT ends rated for 10,000 psi working pressure. Body is connected to bonnet with a rugged, steel hammer lug union nut. This makes it possible to remove internal parts through top of the body without removing the body from the line. Union nut also serves as a jack to start the internal parts out of the body.

Orifices are available in Stellite* and tungsten carbide trim in ¼″, ⅜″, ½″ and ¾″ diameters.

A safety lock device is included, as standard, to prevent bonnet from being removed while body is still under pressure.

*TM—Haynes Stellite Co.

FISHER TYPE 667-HC

Topwork can be fitted with handjack for manual operation.

Pneumatic output signal from instrument or controller.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD... CHANCES ARE IT'S CONTROLLED BY...

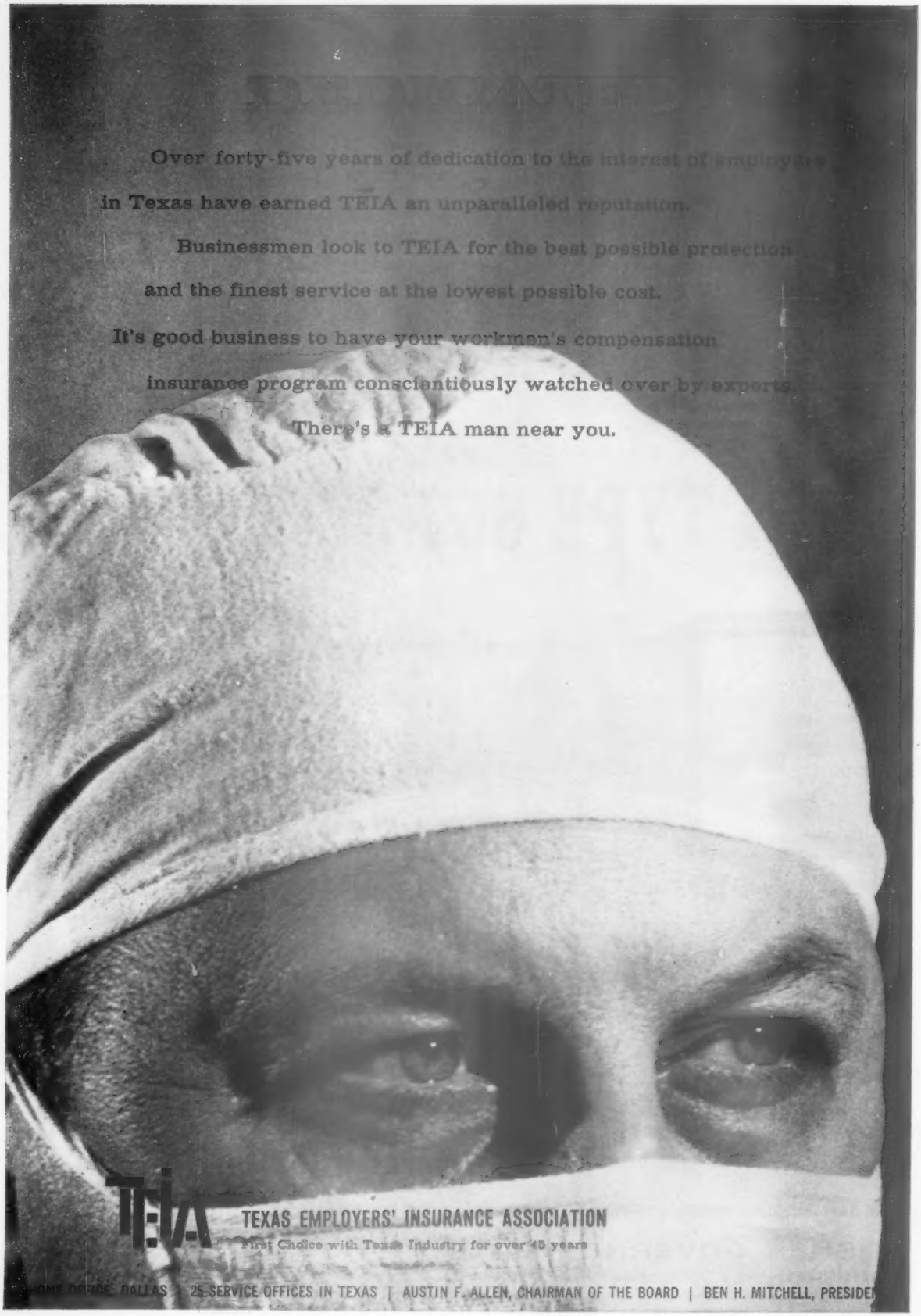
FISHER GOVERNOR COMPANY

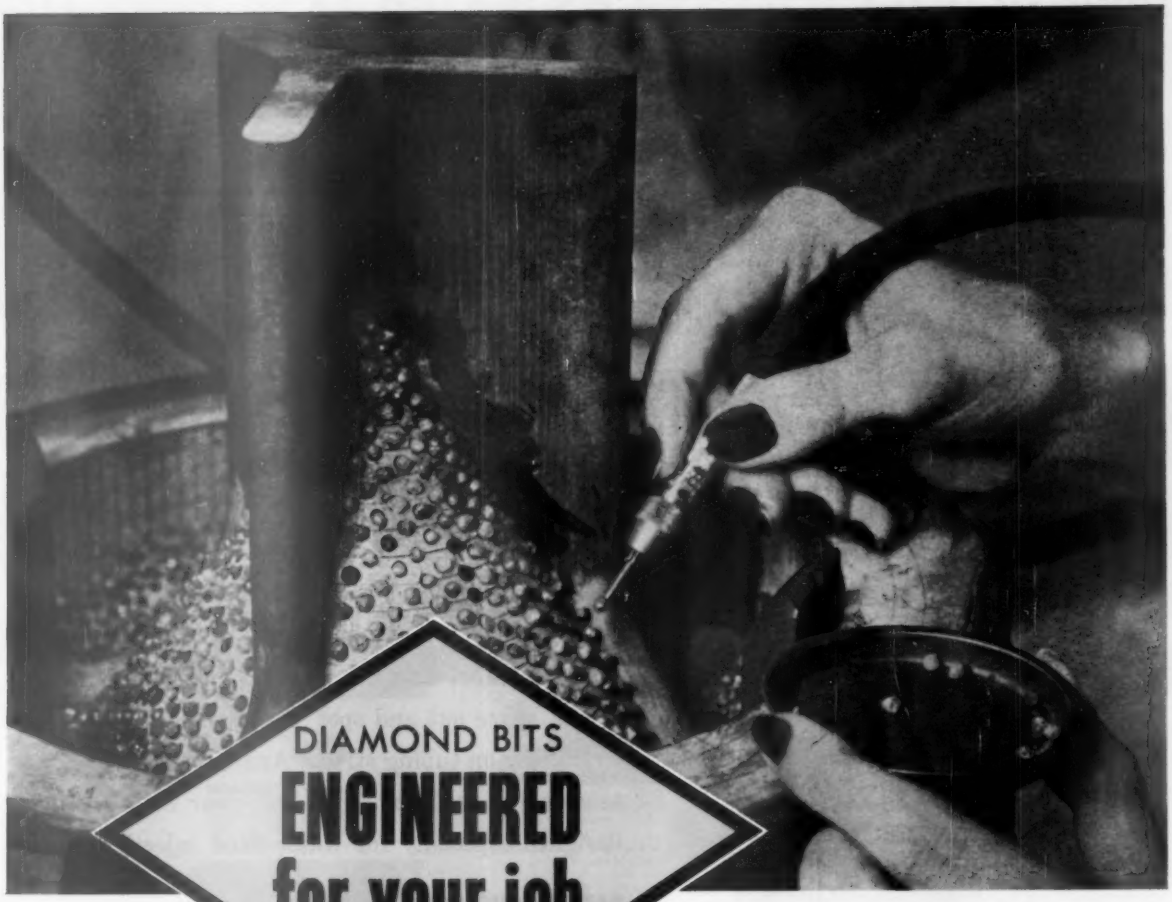
Marshalltown, Iowa / Woodstock, Ontario / Rochester, England

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT CO., CORAOPOLIS, PENNSYLVANIA

FISHER® Controls

SINCE 1880


Over forty-five years of dedication to the interest of employers
in Texas have earned TEIA an unparalleled reputation.
Businessmen look to TEIA for the best possible protection
and the finest service at the lowest possible cost.
It's good business to have your workmen's compensation
insurance program conscientiously watched over by experts.
There's a TEIA man near you.
TEIA
TEXAS EMPLOYERS' INSURANCE ASSOCIATION
First Choice with Texas Industry for over 45 years
HOME OFFICE: DALLAS | 25 SERVICE OFFICES IN TEXAS | AUSTIN F. ALLEN, CHAIRMAN OF THE BOARD | BEN H. MITCHELL, PRESIDE



DIAMOND BITS

ENGINEERED for your job

mean

"Less Cost Per Foot"

And to assure you of "less cost per foot" drilling, Christensen engineers each bit to meet a specific drilling requirement. The waterways, matrix and style are designed for correct diamond placement, concentration and size. The diamonds are carefully sorted into proper sizes and graded to assure uniform quality. Then they are hand set by Christensen's staff of experienced technicians to be sure that the best cutting side of the diamonds works for you. The proper diamond exposure is determined by the formation in which the bit will be used. This combination of Christensen custom engineering and smooth cutting diamonds means top performance for you regardless of hole size, circulating medium or type of formation.

Diamonds Mean, "Less cost per foot."

CHRISTENSEN DIAMOND PRODUCTS

MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST
P. O. BOX 387 SALT LAKE CITY, UTAH

To obtain faster penetration, straighter holes, fewer round trips and better diamond usage, call the Christensen representative nearest you for additional information about diamond bits and core barrels engineered for your job.

SHORT COMPACT RUGGED

GUIBERSON'S SHORTY TENSION PACKER *for* WATER FLOODING

Here is a rugged, low-cost retrievable tension packer that's short and easy to handle. Uncomplicated and functional in design, it's easy to set, space out and spot . . tension set by pulling on tubing string. And Guiberson's shorty tension packer is priced to cut your costs . . designed especially for water flood injection wells.

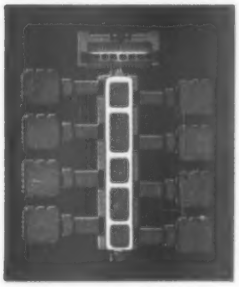
SAFETY JOINT COUPLING: right hand release 8 round thread for added safety.
ANCHOR CAGE: one piece malleable iron.
MANDREL: full opening heavy one piece seamless steel tubing.
LATCH: dependable J-slot mechanism, shock-absorber equipped, independent of safety joint operation.
FRICTION PADS: heat-treated pearlitic malleable iron.
SLIPS: heat-treated alloy steel.
HEADS: drillable cast iron.
RUBBER: specially compounded to withstand the most rugged oilfield use at high pressures and temperatures—built-in ability to return to original shape.
THIMBLE: drillable cast iron.
SAFETY RELEASE NUT: predetermined tension load at packer strips out, leaving safety nut, thimble, rubber and head—all drillable.

Sold by Oil Field Supply Stores Everywhere

THE GUIBERSON CORPORATION

ESTABLISHED 1919 — DALLAS, TEXAS U. S. A.

WILL YOUR NEXT BALANCED OPPOSED COMPRESSOR HAVE ALL OF THESE "HIDDEN VALUES"?



No, it won't! Even if you choose a Worthington compressor, you'll get only 23 of the 24 "hidden values" pictured below. (Just to pique your interest one is fictitious. For identification of the phony feature, see page 267.)

Compressors should be evaluated on performance, we think you'll agree. But performance is determined by factors which aren't easily checked against service conditions and data. These are the factors we call "hidden values." It will pay you to evaluate these values the next time you specify a compressor. Worthington Corp., Clinton Street and Roberts Ave., Buffalo 5, N. Y. 36-8

WORTHINGTON

OPTIC COMPARATOR is used to check connecting rod bolt threads for uniform angles, lead and form.

WIRE ALIGNMENT during assembly using electronic equipment minimizes field alignment problems.

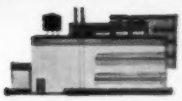
FACTORY ASSEMBLY of intercooler and interstage piping reduces installation problems and costs.

COMPOSITION TEST determines constituents of molten iron in each ladle before any casting is poured.

HONING of connecting rod crankpin and crosshead pin ends results in tighter fits, no loose shells.

INTEGRATED DIV. includes foundry, manufacturing, sales, service and engineering in one location.

ULTRASONIC TEST— an advanced method of examining certain critical parts for internal quality.



$1,000,000 ADDITION TO LABORATORY assures sound equipment designs based on actual research.

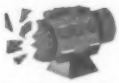
ANALOG/COMPUTER simulates wide range of actual operating conditions for optimum design analysis.

PROFILOMETER inspection of highly finished parts assures easy break-in and long life.

KOLENE PROCESS removes impurities from bearing shell that weaken bond between it and babbitt.

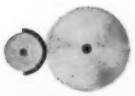
CAST-IN LUBE OIL SYSTEM with internally drilled oil passages eliminates crankcase "plumbing."

MAGNAFLUX AND MAGNAGLO inspections are widely used to expose surface imperfections.



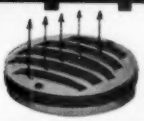
DESTRUCTION TEST of complete compressor cylinders verifies engineers' design calculations.

REMOVABLE DOWEL locks piston rod to crosshead — prevents turning due to loosened crosshead nut.



FINISHED GROUND BEARING SHELLS provide positive full-contact backing for long life.

PARCO-LUBRITING of critical wearing surfaces completely eliminates most start-up scuffing problems.



FEATHER VALVE— industry's preferred compressor valve—is efficient, quiet, and low in maintenance.

STEEL TIE BAR, keyed and bolted in place, strengthens frame and maintains the original alignment.

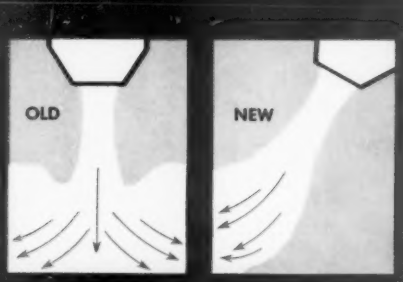
CROSSHEAD SLIPPER ADJUSTMENT within one-thousandth of an inch assures much longer packing life.

THERMODYNAMICS SECTION analyzes each application to size unit and determine its performance.

SALES AND SERVICE INTEGRATION recognizes kinship of one to the other. One man administers both.

ADJUSTABLE ROLLER MAIN BEARINGS feature low friction losses which help to extend compressor life.

AIR CONDITIONED GAUGE ROOM has master gauge blocks constantly used to check instruments.



New SLANT-JET means
every tooth gets a cleaner bite

AMERICAN ASSOCIATION OF OILWELL DRILLING CONTRACTORS MEMBER

THREE CONE BITS

REAMERS

*PAT. PENDING.
Cost-cutting Performance
32 YEARS OF SERVICE
TO THE PETROLEUM INDUSTRY

DRILL COLLARS

REAMING BITS

Announcing

SLANT-JET*

the greatest advance in Jet Bit Design in over a decade

Chicago Pneumatic proudly announces its new SLANT-JET Three Cone Rock Bit . . . the result of more than two years of intensive research and field test. We feel this is the greatest advance in bit design since the introduction of the first jet bit.

The forward inclination of all nozzles on the new SLANT-JET Bit directs streams of fluid that clean hole bottom fast . . . insure every tooth a cleaner bite!

This all-new concept in jet bit design means outstanding performance records . . . more footage, *faster*. Here is a jet action that you can always be sure is cleaning hole. The SLANT-JET stream pries and blasts cuttings loose. Its powerful sweeping action moves cuttings in the direction of bit rotation, keeps all fragments clear of oncoming teeth, then gives them a positive start toward surface. New, clean formation is always exposed. Not an ounce of cleaning effort is wasted as with conventional jet bits. There is no tendency to hold cuttings on bottom or scatter them into the path of the approaching cone teeth.

CP SLANT-JET Bits are available *now* for immediate shipment in sizes of 6″ to 6-3/4″. The 7-7/8″ size is being issued in limited quantities, and other sizes will be available as soon as possible.

*PAT. PENDING

Chicago Pneumatic FORT WORTH, TEXAS

Your USG Distributor can help you . . .

PICK Ni-Span "C" low pressure elements for exceptional thermal stability.

PICK exact Bourdon tube to meet stress, over-pressure, pressure range.

PICK Supergauge® for long life, accuracy to 0.5%.

PICK Solfrunt® for accuracy to 0.5%, solid-front safety from blow-outs.

can show you faster deliveries, more savings, widest choice

A closer look, for example, at the time spent in buying gauges from this source and that . . . or at the cost of not getting the right gauge for the right job. Then—a closer look at the nearest United States Gauge distributor . . . his facilities, service, skills in application engineering, and his USG line. He can help you pick from over 50,000 standard USG indicating dial pressure gauges . . . and thousands more in specials. The widest choice anywhere! He can streamline gauge buying, tighten up on costs, help you get the gauge accuracy and performance you need for the purpose and price . . . with one line that covers 99% of your gauge needs. Note the few examples illustrated here. Then, check the Yellow Pages for a line to your United States Gauge distributor and *simplified* money-saving *one source* buying. Or write direct for catalogs and name of your distributor.

UNITED STATES GAUGE

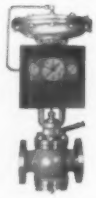
Division of American Machine & Metals, Inc. • Sellersville, Penna.

PICK Test Gauges for dependability, and accuracy as high as 0.2 of 1%.

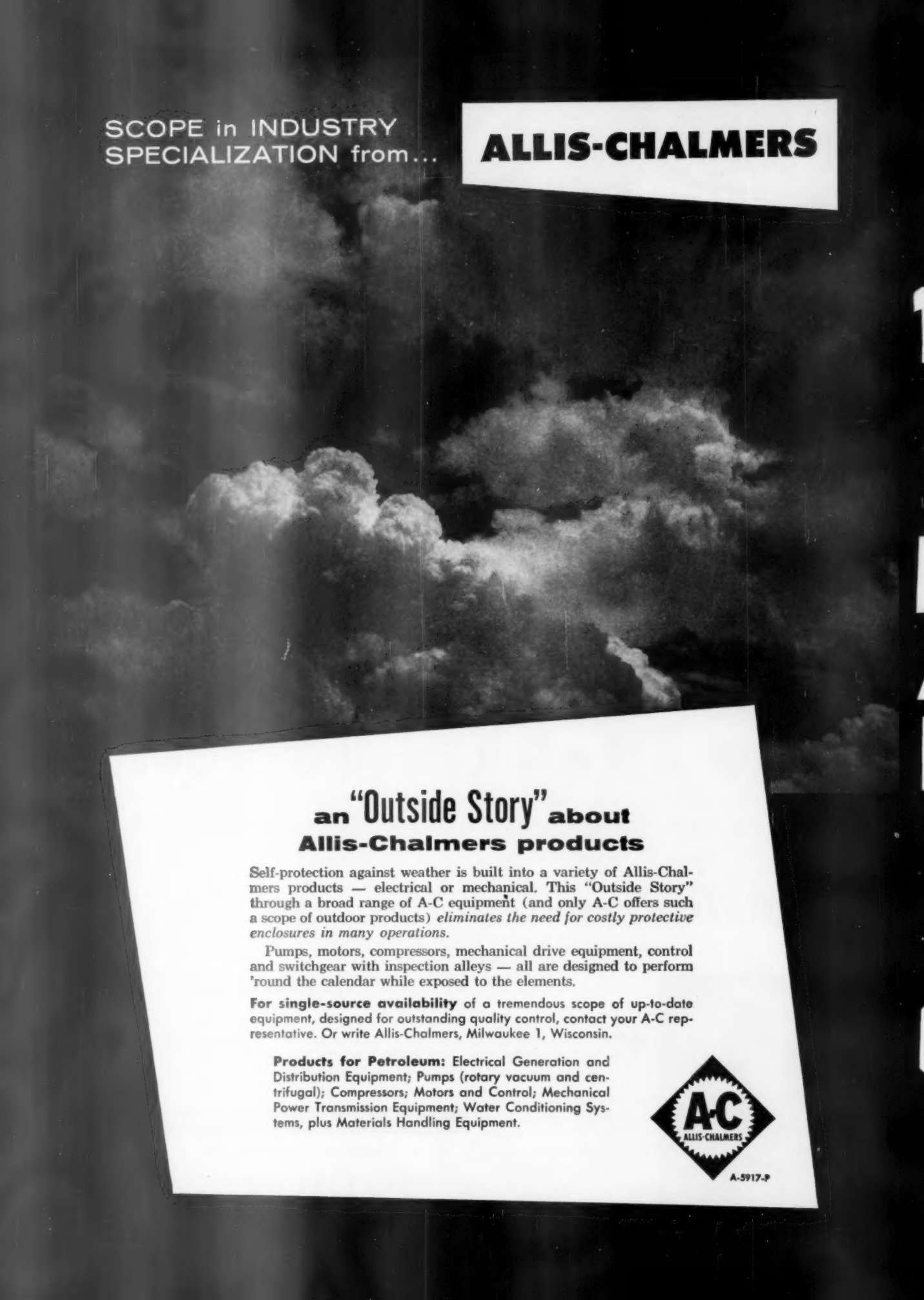
PICK Recorders and Recording Controllers built to stand vibration, pulsation.

PICK A-Line for premium reliability, accuracy to 1%, and savings up to 40%.

PICK Arc-Loc® Movement for longer life, easier and lower maintenance.



PICK U. S. Gauge Indicating Controllers or Transmitters for reliability.



an "Outside Story" about Allis-Chalmers products

Self-protection against weather is built into a variety of Allis-Chalmers products — electrical or mechanical. This "Outside Story" through a broad range of A-C equipment (and only A-C offers such a scope of outdoor products) *eliminates the need for costly protective enclosures in many operations.*

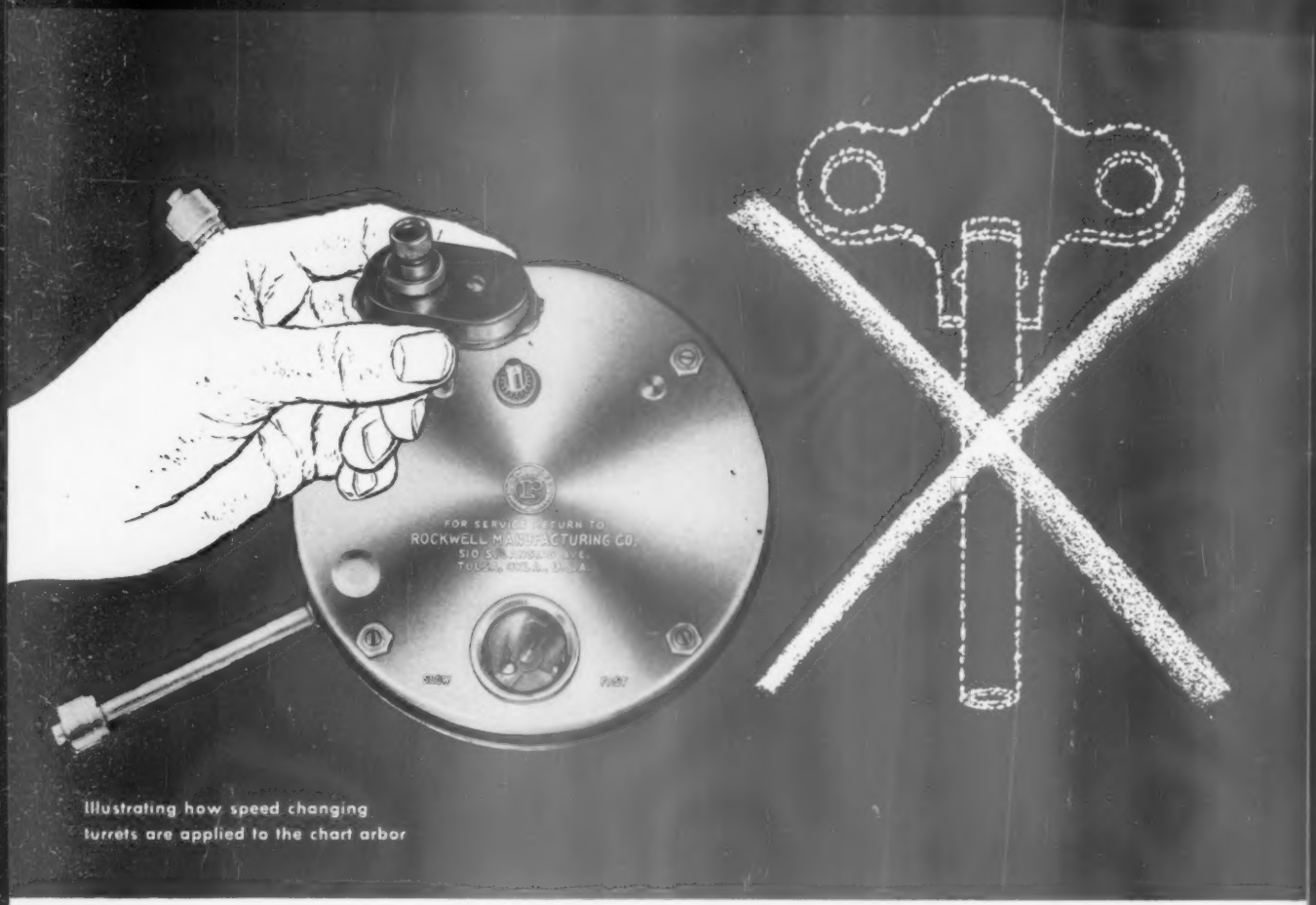
Pumps, motors, compressors, mechanical drive equipment, control and switchgear with inspection alleys — all are designed to perform 'round the calendar while exposed to the elements.

For single-source availability of a tremendous scope of up-to-date equipment, designed for outstanding quality control, contact your A-C representative. Or write Allis-Chalmers, Milwaukee 1, Wisconsin.

Products for Petroleum: Electrical Generation and Distribution Equipment; Pumps (rotary vacuum and centrifugal); Compressors; Motors and Control; Mechanical Power Transmission Equipment; Water Conditioning Systems, plus Materials Handling Equipment.

A-C ALLIS-CHALMERS

A-5917-P



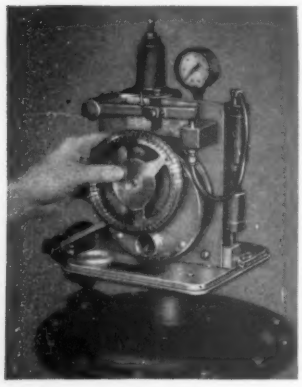
Illustrating how speed changing turrets are applied to the chart arbor

You never need to wind the Rockwell Gas Drive

GAS (OR AIR) POWERS THIS NEW CHART TIMING DRIVE. With it you can forget the costly chore of periodic winding. It's completely self-starting, self-contained. You can use the Rockwell Gas Drive with profit and gain accurate, automatic operation of recording charts on practically any make orifice meter, gas lift intermitter, pressure recorder or temperature gauge. It is particularly applicable for remotely located instruments.

Since the Rockwell Gas Drive consumes only 6 cubic feet of gas in 24 hours it is economical to use—safe, too, for there is no exhaust problem.

The Gas Drive operates on a pressure range of 15-25 psi and delivers 15 in. lbs. of torque to the main arbor which rotates once every 24 hours. Geared turrets which snap onto this arbor provide optional speeds of 2, 3, 4, 6, 12, 48 or 72 hour, 7 or 8 day rotation. So with a stock of Rockwell Gas Drives, plus a selection of economical turrets, you can serve all your instrument needs. Get facts now. Write Rockwell Manufacturing Company, Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Guelph, Ontario.



◀ Rockwell Gas Drive powers this typical intermitter

GAS DRIVES, CHART DRIVES

another fine product by

ROCKWELL

ALLIS-CHALMERS

A-1235

ACID AREA APPLICATION. Safety equipment and clothing are a "must" for personnel in the acid atmosphere of Dow's chlorine plant at Freeport, Texas. This **Super-Seal** motor came prepared, too — with **Poxeal** insulation guarding the stator.

Nothing...but nothing...stops Super-Seal motors

In a tough acid pump installation, Dow Chemical's Texas Division experienced no end of motor troubles. It seemed nothing could stand up in that humid, corrosive atmosphere. Reports Dow: "Even with totally enclosed motors, winding failures were frequent." And, they might have added, expensive.

Then came *Super-Seal* motors— with amazing *Poxeal* insulation. A durable case of epoxy-resin encloses the winding end turns and slot portions of the stator . . . the most complete protection ever developed. Result? The *Super-Seal* motor, *after two years* of continuous operation in the acid area, is as good as ever. So good, in fact, that Dow has ordered 150 *Super-Seal* motors for a new chemical plant at Freeport, Texas.

Isn't it time to revaluate *your* motor standards? There's a good chance that *Super-Seal* motors can solve your motor problems, too. Contact your A-C representative or distributor, or write **Allis-Chalmers,** General Products Division, Milwaukee 1, Wisconsin.

Super-Seal and *Poxeal* are Allis-Chalmers trademarks.

Morse HY-VO® shatters roller-chain speed barrier!

HY-VO TRAVELS FASTER . . . LASTS LONGER!

Morse Hy-Vo drive travels far beyond the speed limitations of roller chain. Hy-Vo delivers up to 13,250 fpm. It runs *faster*, smoother, cooler, quieter and lasts *longer*. Application after application in oil field service, for over nine years, proves that Hy-Vo pays for itself. It permits rig manufacturers and drillers to use lower cost, high-speed, more mobile engines. And, unlike roller chain, Hy-Vo needs no special tools to assemble or disassemble it in the field.

For high speed . . . high horsepower applications, Hy-Vo drives outperform and outlast all others. Get the money-saving facts today. Write: Morse Chain Company, Dept. 22-30, Ithaca, N.Y. Export Sales: Borg-Warner International, Chicago 3, Ill. In Canada: Morse Chain of Canada, Ltd., Simcoe, Ontario.

OIL FIELD WAREHOUSES: Casper, Wyo.; Charlotte, N.C.; Chicago, Ill.; Farmington, N.M.; Hobbs, N.M.; Houston, Tex.; Los Angeles, Calif.; Odessa, Tex.

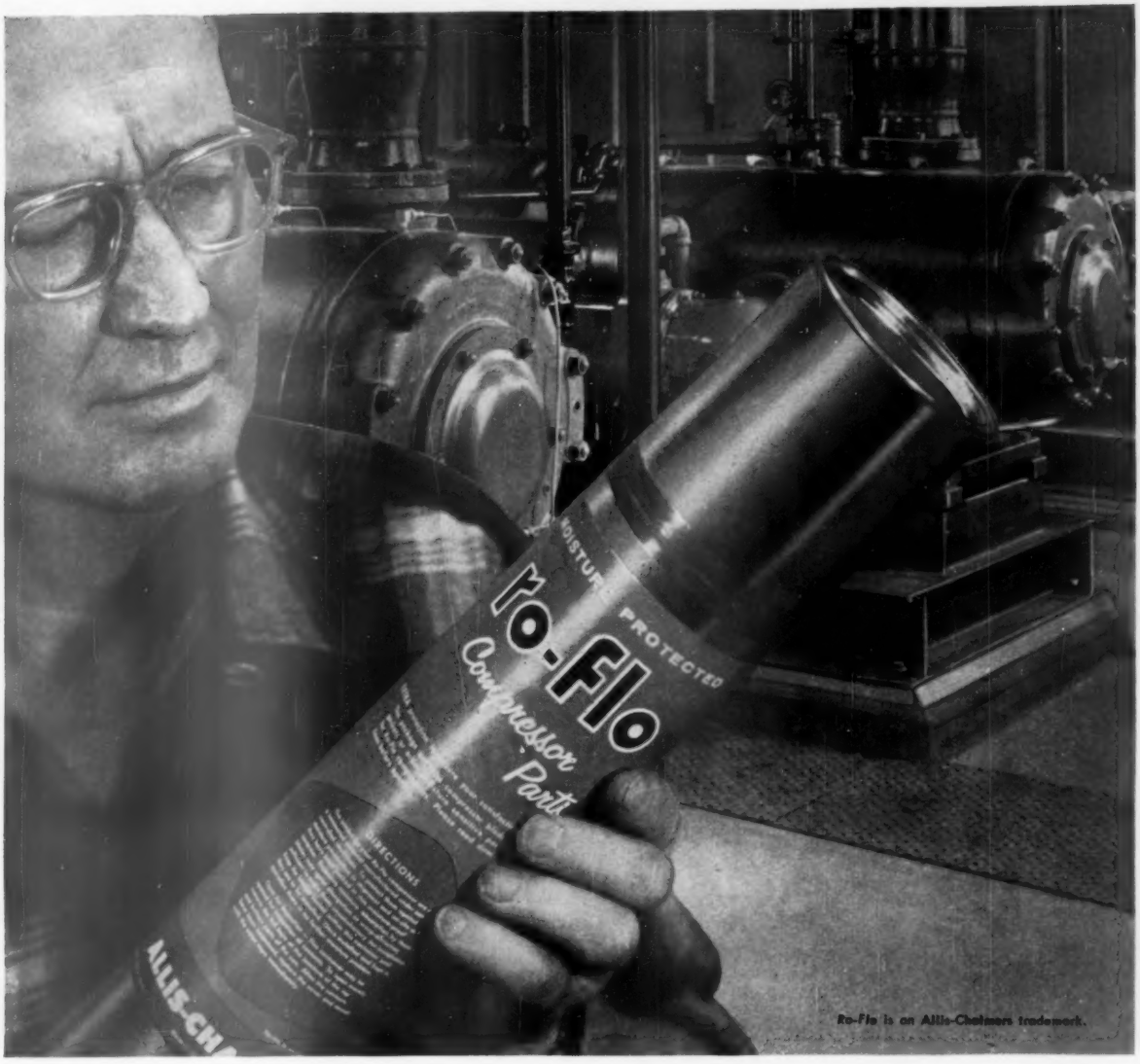
COMPARISON – based on 500 hp 1½" chain—25-tooth sprocket

ROLLER CHAIN		HY-VO
WIDTH	7½" 4 strand	5"
SPEED LIMITATION	4,400 fpm 1,400 rpm	13,250 fpm 4,250 rpm

MORSE B-W

A BORG-WARNER INDUSTRY

ALLIS-CHALMERS



Imagine! A package this small

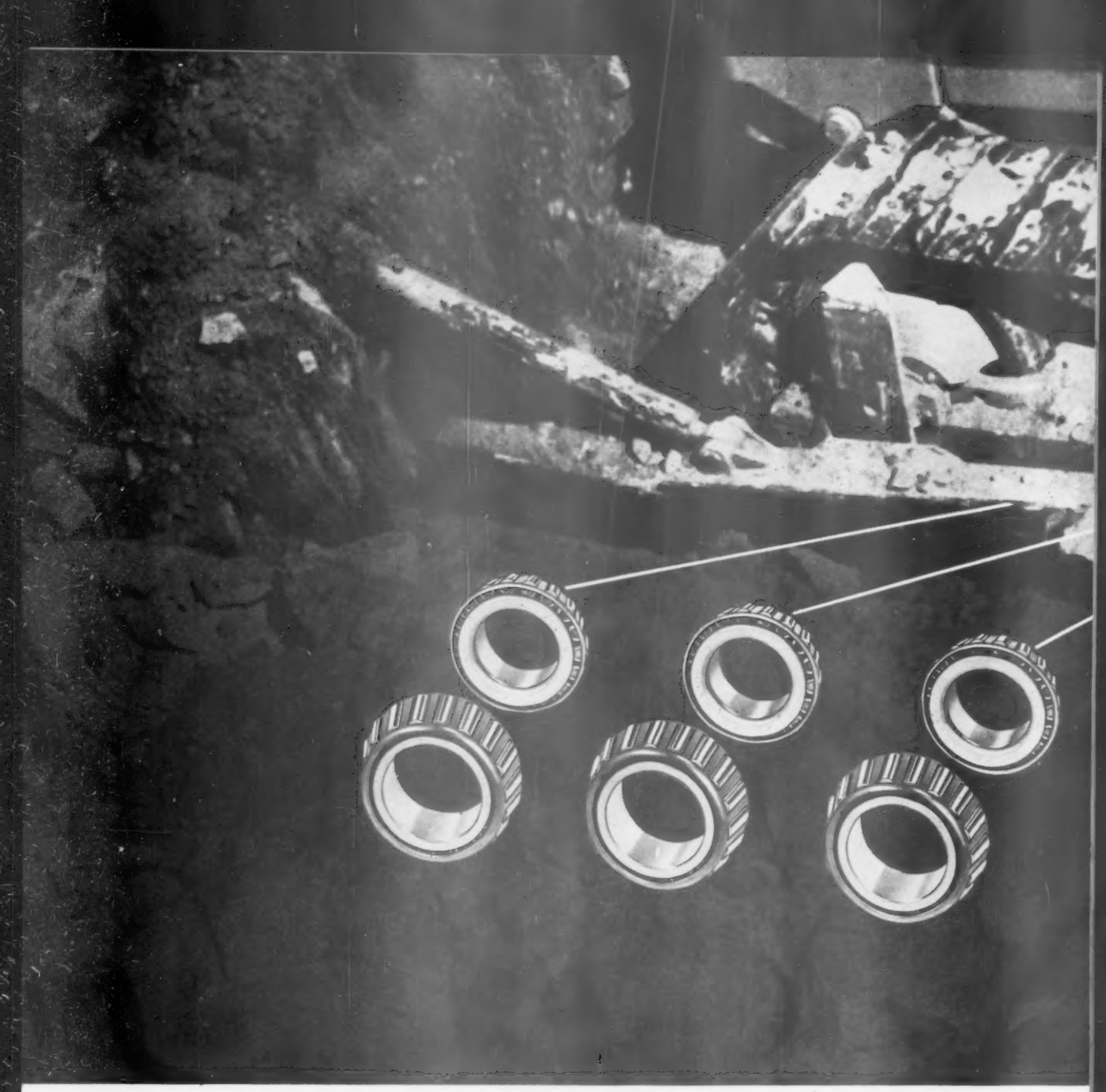
contains the spare parts for your Ro-Flo compressor

A spare parts kit you can hold in your hand — dramatic evidence of the continuous, trouble-free performance that is yours with a *Ro-Flo* compressor.

You need fewer spare parts because there are fewer moving parts to wear out. No pistons, no valves, no connecting rods. Besides the bearings and seals, which all units have, only the rotor blades are exposed to normal wear, and rotary design compensates for it — automatically, by centrifugal force. Average blade life is two to three years, and when finally worn, blades can be replaced in one simple operation.

Smooth rotary motion of the *Ro-Flo* compressor eliminates the vibration and pounding shock of reciprocating units — and the necessity for expensive, heavy foundations. A slab is enough. Smaller units can be mounted directly to the floor.

Two-stage *Ro-Flo* compressors are built in twelve sizes to handle from 250 to 1800 cfm at pressures from 60 to 125 psig. Single-stage units up to 50 psig, from 40 to 3000 cfm. *Ask your A-C representative for descriptive literature, or write* **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1270



MORE WORK POWER

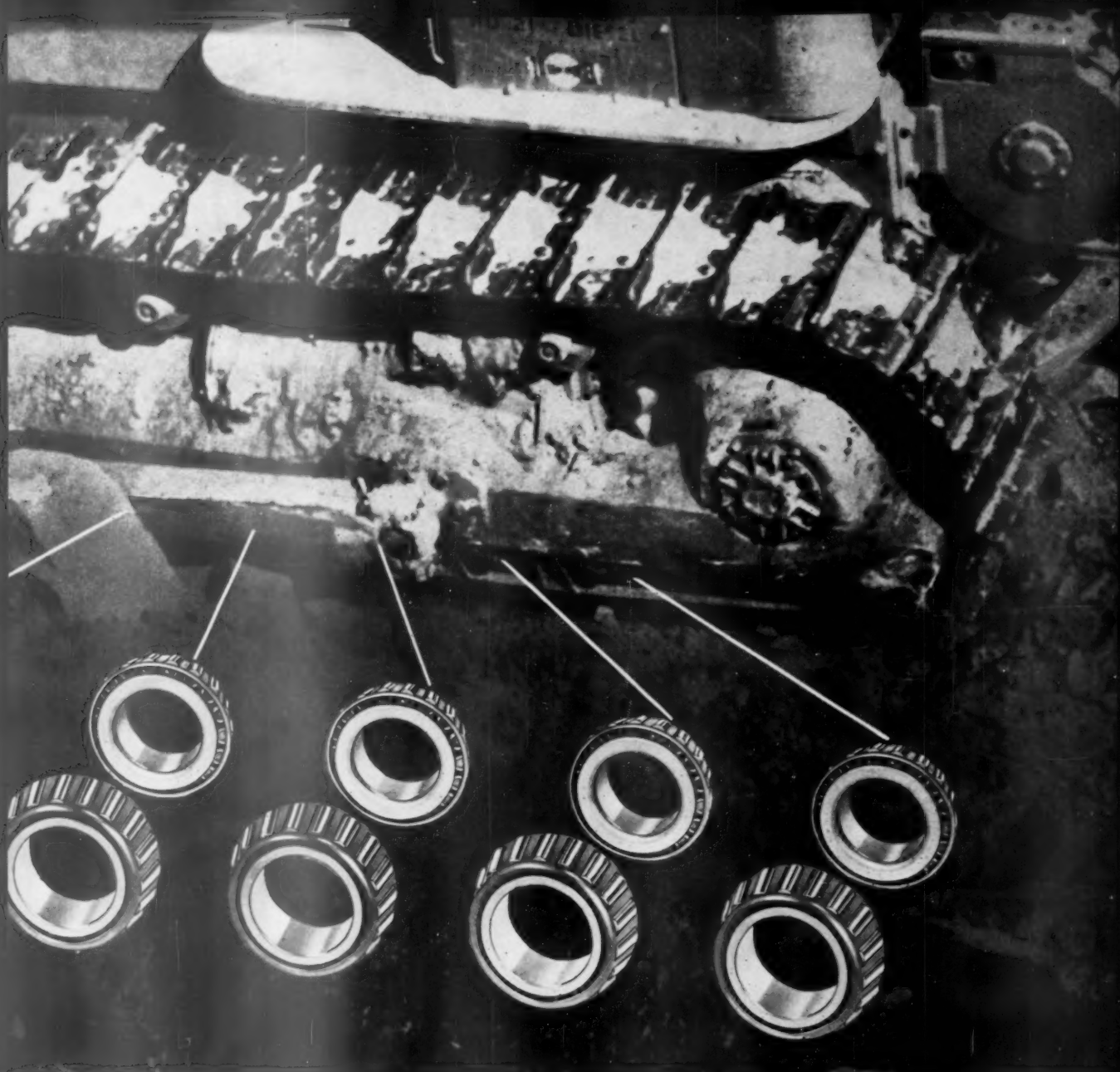
Reduced friction through use of tapered roller bearings in all Allis-Chalmers crawler tractors makes the difference in work power and profit for you!

All Allis-Chalmers crawler tractors roll on tapered roller bearing truck wheels. Most others still use bushings.

Anyone who remembers his roller skating days knows the performance advantages of bearings over bushings. The difference between first and also-ran was in the wheel bearing. This friction-reducing advantage is the reason railroads all over the country have turned to *roller* freight.

The same principle applies to tractors except much more power is being wasted by friction-type plain bushings. It's one of the reasons the 225-hp HD-21, on tapered roller bearings, produces right alongside the biggest tractors you can buy. Can you

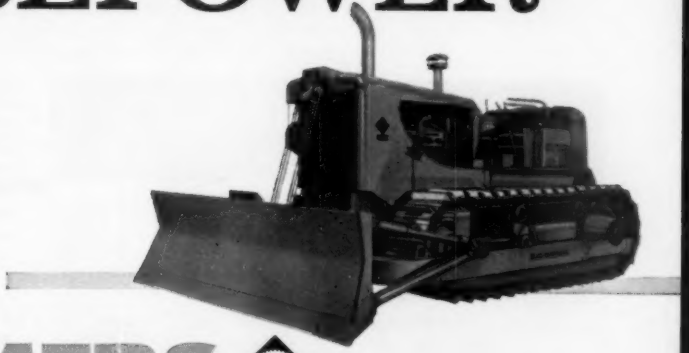
move ahead with



PER HORSEPOWER

continue to pay for power that *never* produces—that gets "lost" in old-fashioned bushings?

Your Allis-Chalmers dealer will be glad to discuss this and the many other advantages that keep the HD-21 on the go shift after shift with a minimum of maintenance. Ask about the *toughest track ever built . . .* the *industry's healthiest engine* and *certified permanent lubrication*. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wis.



ALLIS-CHALMERS

power for a growing world

TOLAD® FUEL ADDITIVE

a NEW Tretolite product

IMPROVES FUEL "COLOR STABILITY" AND REDUCES RESIDUE AT LOWER COST

TOLAD* Fuel Additive formulations have been thoroughly tested in Tretolite laboratories and spot commercial applications for over two years. In test after test, TOLAD has improved fuel oil color stability, dispersed insoluble residue, and reduced sludging characteristics, and has done so at a lower cost than the commercial additive which it replaced.

FURNACE FUELS

TOLAD Fuel Additive enhances the salability of domestic furnace fuels in storage by inhibiting the formation of insoluble residue, preventing the formation of sludge and retarding color degradation.

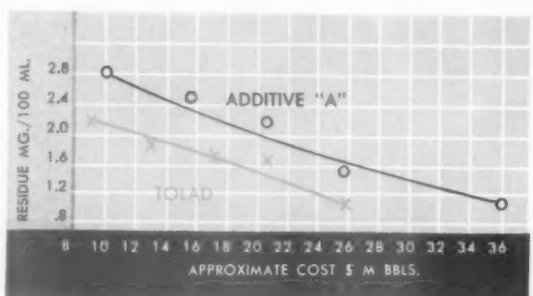
DIESEL FUELS

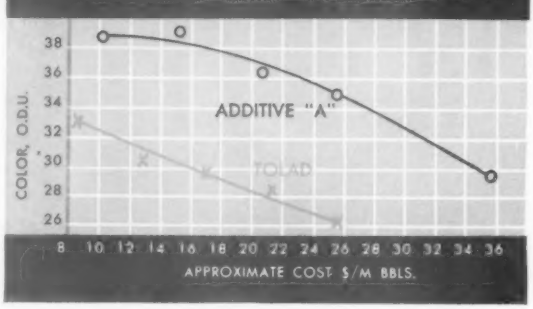
Diesel fuel sludge is the prime cause of plugging in fuel filters, injection systems and burner nozzles. TOLAD Fuel Additive improves the performance characteristics of diesel fuels by preventing the formation of sludge.

Whenever fuel deterioration is caused by long storage periods, TOLAD additive will *economically* help to maintain fuel quality and salability.

For complete information, ask your Tretolite refinery service engineer, or write to

The graphs illustrate TOLAD'S ability to improve color and residue characteristics of fuel in storage more economically. In these tests, a commercial furnace oil was subjected to a 12 week 110°F oven storage test. TOLAD was added to one sample, another commercial additive to the other. At every reading, TOLAD effected the desired color or residue characteristics at a lower per-barrel-cost.





*Registered Trademark, Petrolite Corporation

FA-60-2

PETROLITE CORPORATION

TRETOLITE COMPANY
DIVISIONS
369 Marshall Avenue, Saint Louis 19, Missouri
5515 Telegraph Road, Los Angeles 22, California

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COLOMBIA: South American Petrolite Corporation, Bogota
ENGLAND: Petrolite Limited, 20 Savile Row, London W.1
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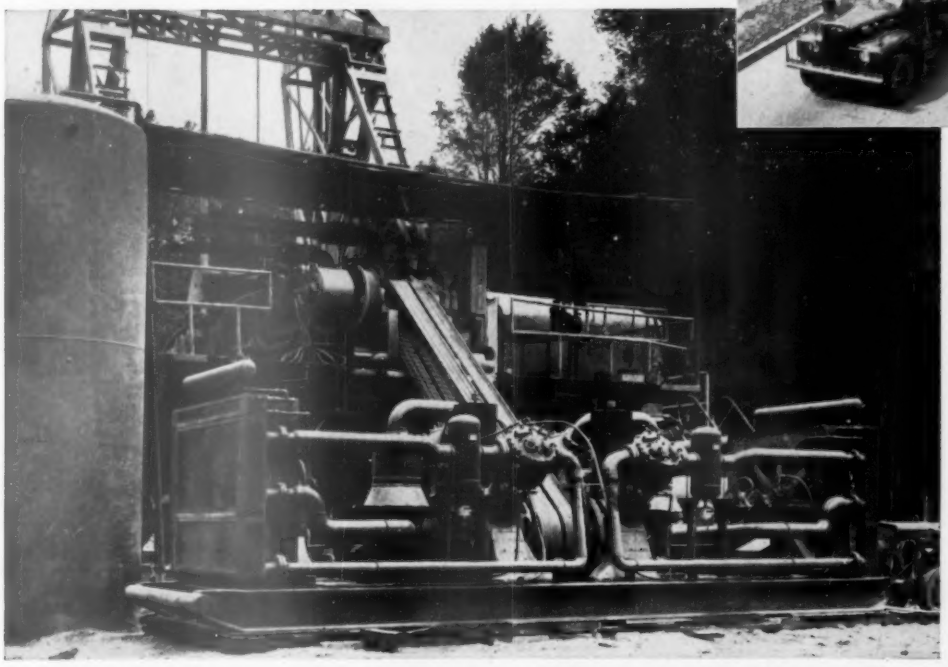
For air drilling anywhere . . .

JOY COMPRESSORS

with over-the-road portability



Joy AR-1 rig driven compressor operating in West Virginia after long haul over dirt roads.

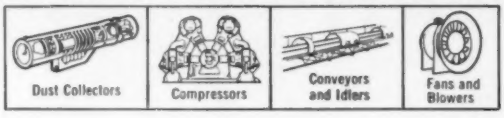
Joy "package" air drilling compressors are mounted on a single skid, completely within normal size limits for highway transportation. The bother and delay of special transport permits is eliminated.

These Joy compressors are designed specifically for air drilling service. The compressor units are built with the same durability found in rugged, heavy-duty stationary machines. All are designed for continuous operation over long periods.

One added advantage: remote controls at the driller's console permit the driller to operate the entire unit. An extra man at the compressor is unnecessary. Automatic controls regulate compressor loading and unloading at discharge pressure settings.

Air drilling operators can choose from three different self-driven or rig-driven models. Capacities from 50 to 6300 cfm; pressures from 52.5 to 500 psig. Find out more about Joy "package" compressors for fast air drilling plus fast over-the-road hauling. For additional information, write for bulletin 766-31.

AIR MOVING EQUIPMENT FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

hē'li-ŭm

When you consider Helium-Recovery you will automatically think of Stearns-Roger.

Most of the operating helium plants in the free world have been built by Stearns-Roger. In this one organization is collected the cryogenic knowledge, experience and practical background to engineer and construct economical and satisfactory helium plants.

Stearns-Roger can provide you with reliable designs, investment studies and overall assistance in helium, hydrogen, natural gas and rare gas problems.

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P.O. BOX 5370 ▼ DENVER 17, COLORADO

RUST-OLEUM®

STOPS RUST!®

and matches ORIGINAL EQUIPMENT

COLORS

Distinctive as your own fingerprint. Accept no substitute.

How much does rusty equipment cost *you*? With Rust-Oleum, you STOP RUST—and you match original equipment colors, too, for long-lasting protection!

We want you to see for yourself how *easy* it is to use Rust-Oleum . . . actually take the brush and see how smoothly it works, how it dries to an *attractive, high-gloss finish* that resists sun, fumes, rain, heat, snow, salt air and salt spray, and blowing dust and sand. And the same formula can be applied by brush or spray. Just check the coupon for the color you want . . . and attach it to your business letterhead for a FREE TEST SAMPLE. No cost or obligation.

Your Rust-Oleum Distributor maintains complete stocks for immediate delivery.

ATTACH COUPON TO YOUR BUSINESS LETTERHEAD FOR FREE TEST SAMPLE

CHECK COLOR TO MATCH YOUR EQUIPMENT

RUST-OLEUM CORPORATION, 2624 Oakton St., Evanston, Ill.

Please send me a FREE TEST SAMPLE in the color checked:

- ☐ 769 Damp-Proof Red Primer
- ☐ 634 Quick Drying Black
- ☐ 2766 High Gloss White
- ☐ 470 Ready Mixed Aluminum
- ☐ H-4 Caterpillar Yellow
- ☐ 722 Bethlehem Yellow
- ☐ 726 New Emsco Green
- ☐ 727 New Unit Rig Gray
- ☐ 724 Waukesha Gray
- ☐ 721 National Blue
- ☐ 723 Oil Well Orange

accuracy

ASHCROFT DURAGAUGES measure pressure with precise accuracy no matter how severe the conditions of service

Ashcroft Duragauges are available in pressure ranges from 15 psi (or vacuum) minimum to 100,000 psi. Dial sizes: 4½" through 12".

sustained

The Bourdon tube in Ashcroft Duragauges is manufactured to precision standards of flexibility and mono-linked to the rotary movement. When pressure flexes the tube, the gauge pointer is always positively positioned, because it is mounted on the geared center shaft of the movement. Sustained high accuracy and long life are assured.

Choose your Ashcroft Duragauges made of components best suited to your needs. Eight Bourdon tube materials are available. Movement of stainless steel with nylon bearings and pinion gear for longest wear. Case materials: special aluminum alloy or tough phenol plastic.

The unique "Maxisafe®" Duragauge provides absolute protection to the viewer, plus easy and quick access to the mechanism. Your industrial supply distributor will help you select the best combination of components for your Ashcroft Gauge requirements. Phone him today or write for Catalog 300B.

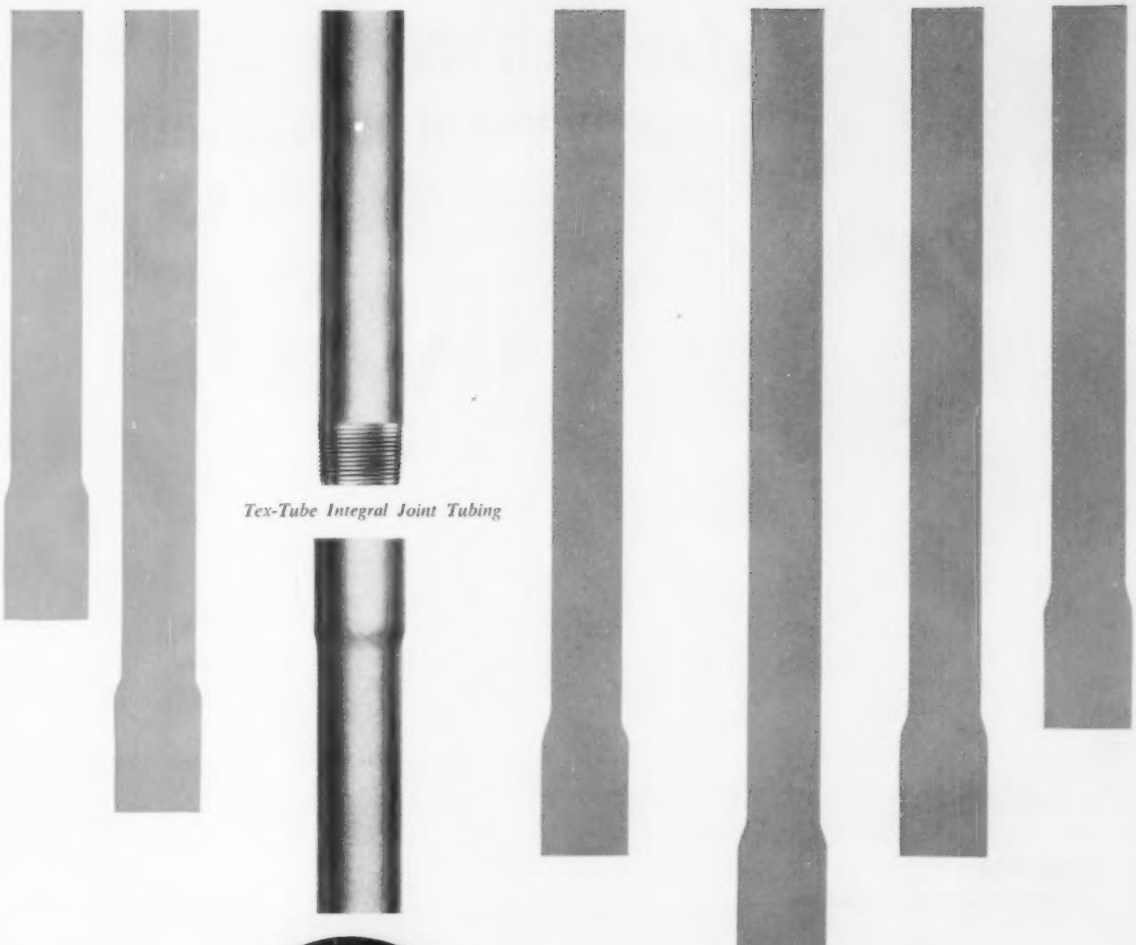
MAXWELL M&M MANNING & MOORE INC. TRADE MARK

ASHCROFT PRESSURE GAUGES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario



Tex-Tube Integral Joint Tubing

IT'S ALL TEX-TUBE...FROM OUTSET TO UPSET

No. 4 Upsetter

Tex-Tube's new Series 301 small diameter oil well tubing in 1¼" and 1½" nominal sizes is the only macaroni tubing made entirely in one mill — from coiled stock to finished product — including upsetting, threading and normalizing.

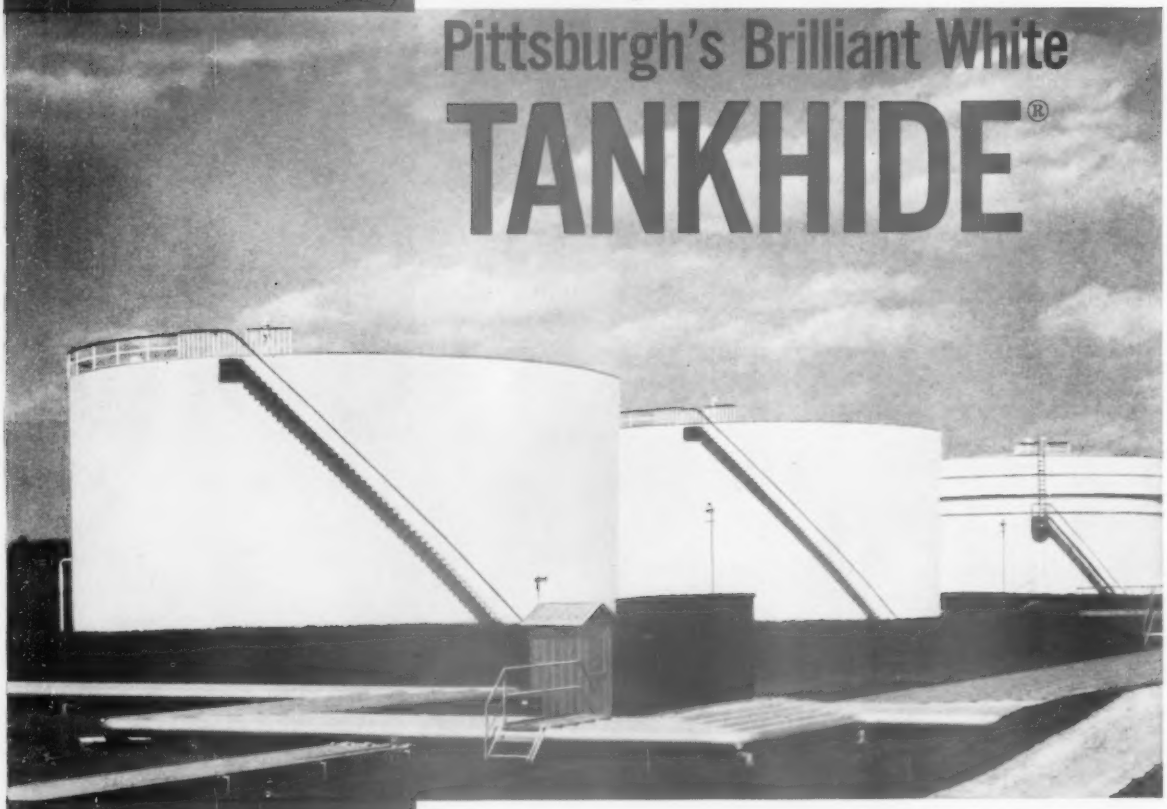
This is your assurance of undivided responsibility for quality and prompt delivery.

Tex-Tube also has complete finishing facilities for, and stocks of, all sizes and grades of standard macaroni tubing from ¾" nominal through 2 1/16" O.D.

TEX-TUBE, INC.

1503 NORTH POST OAK ROAD • HOUSTON, TEXAS
Sales Offices in Midland, Dallas, Tulsa and Los Angeles

Extremely long life... less evaporation loss with Pittsburgh's Brilliant White TANKHIDE®



Pittsburgh's brilliant White TANKHIDE gives you the toughest, most durable protection you can buy for storage tanks—yet it costs less in the long run.

- **Specially formulated** with titanium pigments and weather-resistant vehicles, TANKHIDE resists weather wear and corrosion. These intensely white pigments have unusually high solar reflectance, reducing costly losses from evaporation of volatile petroleum products stored in cone-roof and floating-roof tanks.

- **Pittsburgh's long experience** in producing a wide variety of high-quality finishes for the petroleum industry can save you time and money. Write, wire or phone Pittsburgh Plate Glass Company, Industrial Finishes, 1 Gateway Center, Pittsburgh, Pa.

Watch the Garry Moore Show—CBS-TV—Tuesday Evenings.

PPG

PITTSBURGH INDUSTRIAL FINISHES

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

PITTSBURGH PLATE GLASS COMPANY

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GREATER SELECTION

...another plus value
from **TUBE TURNS**

LIGHT WEIGHT FITTINGS FOR LOWER-COST PIPING!

You can use larger diameters of thin wall steel piping to get greater flow area, lighter weight, lower costs. Tube Turns offers the most complete line of forged light weight welding fittings for these economies. Here is just one of the many PLUS VALUES you get when you specify TUBE-TURN® products.

MORE!

MORE OF 'EM...QUICKER!

Another
PLUS VALUE
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TUBE TURNS' DISTRIBUTOR

Tube Turns' 12,000 stocked items comprise the world's broadest line of welding fittings and flanges. You can buy any of these on *one order,* from *one source*... your nearby Tube Turns' Distributor. This *wide selection and prompt delivery* simplify purchasing, assure matching of specs, reduce job delays, cut costs. Outstanding *availability service* is just one of the many PLUS VALUES you get when you specify and buy top-quality TUBE-TURN* products. Others are shown here.

The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

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ANOTHER tt® PLUS

greater protection...convenience

TUBE-TURN® ALLOY WELDING FITTINGS AND FLANGES ARE INDIVIDUALLY PACKAGED

Here is an important new safeguard... and new convenience... for users of stainless steel, aluminum and other non-ferrous alloy piping. Tube Turns is now individually packaging all its fittings and flanges of these materials. Rugged containers protect each fitting from inspection to job site. And, fully marked, these containers simplify storage and identification.

Here is another PLUS VALUE you get when you specify TUBE-TURN® products and buy from your nearby Tube Turns' Distributor.

MORE!

IN A FIVE-MINUTE TELEPHONE CONVERSATION . . .

This gas processing specialist helped an operator save $3,000 a day

Recently, a West Texas natural gas processor called stating he was flaring sales gas due to high sulfur content caused by foaming in an ethanolamine system. The same antifoamants used successfully for some time were not effective. Subsequent questioning revealed that his gas stream was now at a higher temperature than the amine and a condensation of hydrocarbons resulted. On-the-phone-solution . . . raise the amine temperature to approximately 15° F. above that of the gas stream.

This, of course, was a simple one. More often Jefferson's experienced gas treating specialists will probe for pertinent data, request samples, and coordinate the solution of your problem through Jefferson's Austin Laboratories. Whether your problems be in desulfurization or dehydration . . . corrosion, foaming or contamination . . . Jefferson can draw on a vast fund of case experiences to help you avoid costly shutdowns, gas flaring or excessive solution losses.

For the *right* gas processing answers and chemicals . . . call Jefferson Chemical Company, Inc., 1121 Walker Avenue, P. O. Box 303, Houston 1, Texas.

Ethylene and Propylene Oxides, Glycols, Dichlorides, Carbonates
SURFONIC® Surface-Active Agents • Ethanolamines • Morpholine
N-Alkyl Morpholines • Polyethylene and Polypropylene Glycols
Piperazine • Piperazine Salts • Nonyl Phenol • Caustic Soda

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2-WAY RADIO SERVICE

Remember, too, that Motorola is a maintenance organization . . . with the largest service force specially trained to maintain 2-way radio systems to factory standards. No matter how large your radio system is—how widely distributed your mobile radios are—Motorola can provide system maintenance specifically tailored to your requirements.

For example, one company serviced by Motorola has more than 500 mobile units, 43 base stations and a 200-mile microwave system.

You, too, can have confidence in the service provided under a Motorola Maintenance Agreement. Write today for full details.

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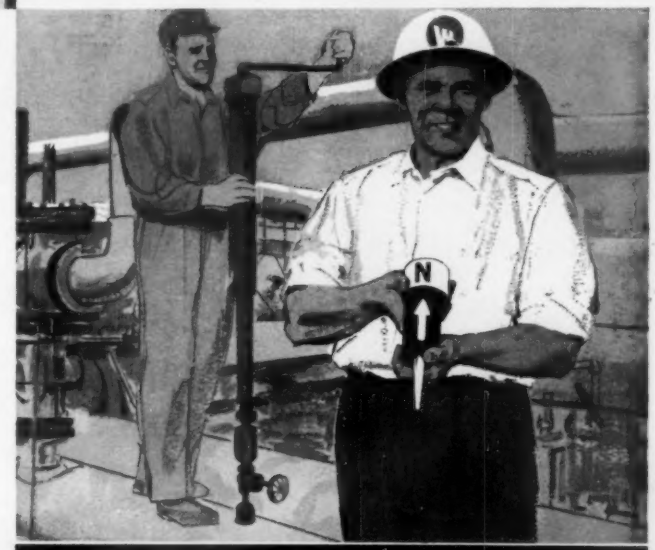
Motorola Communications & Electronics, Inc., 4501 Augusta Blvd., Chicago 51, Ill. A Subsidiary of Motorola, Inc.

NEWS FROM DOWN THE LINE!

NEW WmSON "PIG-SIG II" CAN BE INSTALLED OR REMOVED UNDER PRESSURE!

❷ "The Pig-Sig II with the Electrical Indicator can signal arrival of pig to pump station operator or start operation of automatic equipment to open and close valves."

❶ "The station operator knows the pig has arrived because the Pig-Sig II visual indicator is in the "passed" position. He no longer needs to wait and listen at the scraper trap."



❹ "This completely new Pig-Sig II uses a standard 2" Thread-O-Ring Nipple. Easily installed under pressure with WmSon Tapping Machines, using a standard drill.
The Pig-Sig II is available with either an electrical or visual signal, extended or regular."

❸ "This new, improved long trigger action detects scrapers even in oversize pipe. Pig-Sig II is excellent for use in metering or calibration."

"Pig-Sig II" Patent applied for

• Write for Bulletin A-199

T.D. Williamson, Inc.

P. O. BOX 40 • TULSA 2, OKLAHOMA

REPRESENTATIVES AROUND THE WORLD

Century motors clean water flooding system

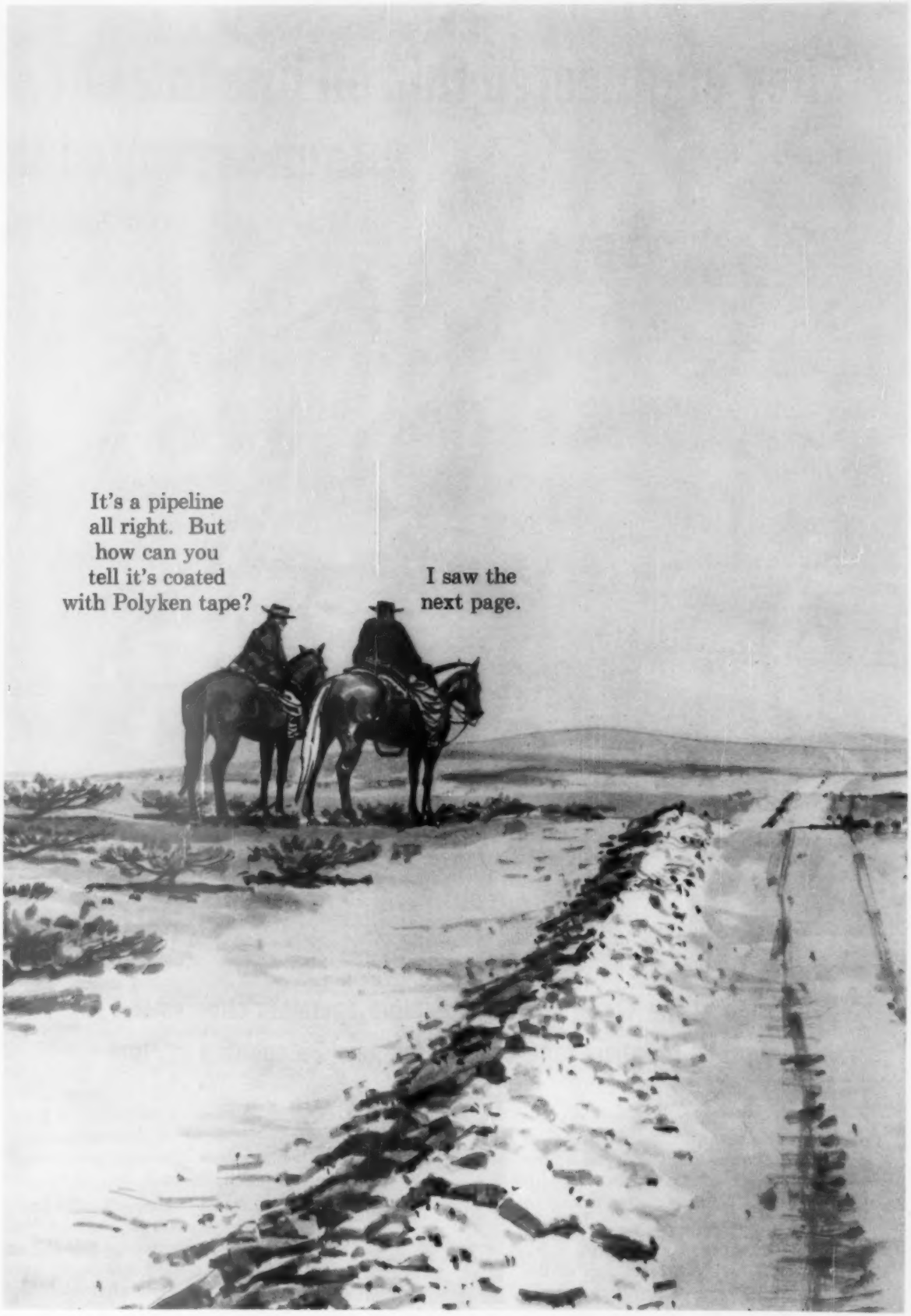
This Century Electric 10 hp motor is driving a back flush pump on a Texas water flooding installation. This motor and others like it are specified for thousands of demanding oil industry applications. You get top performance with Century motors because the load cycle of your equipment can be matched precisely by the performance characteristics of the motor . . . means you get power when and where you want it. Century motors can withstand the severest elements . . . drip- splash- dust- and explosion-proof enclosures are available. Windings are insulated with tough polyvinyl acetal insulation. These and other features add up to dependable motor power and lower operating costs. For more information contact your nearest Century Electric sales office or your supply store.

CENTURY ELECTRIC COMPANY

St. Louis 3, Missouri *Offices and Stock Points in Principal Cities*

Century

60-9


It's a pipeline all right. But how can you tell it's coated with Polyken tape?
I saw the next page.

"They engineered this oil line to a cat's whisker" then wrapped it

One of the world's largest pipeline operators chooses the world's toughest tape coating for new Patagonian oil line

A leading international pipeline company recently wrapped over 100 miles of crude oil gathering and transmission line with Polyken No. 960 Extra-Strength Pipeline Roll. The pipe ranges from 2 to 14 inches in diameter.

An Example of Perfection

The new line, which crosses part of the Patagonian plateau of southern Argentina, is an example of perfection in pipeline design. "They engineered it to a cat's whisker," is the way a seasoned pipeliner put it.

In their construction plans, the engineers specifically called for Polyken No. 960 Tape as the protective coating. Seven years of private testing and study had convinced these people that Polyken

whisker"—
with Polyken tape

Using tensioned-spindle equipment, pipe is cleaned and wrapped in one factory-smooth operation. Polyken tape is always ready. No primer, no drying or cooling. No fumes or fire hazard.

delivers the durable, practical protection that a precision-built line needs. Quite a few other major oil and gas companies have come to share this conviction in recent years.

The Man to See

There's a lot to be said for Polyken tape. There's the frequent, substantial saving, the ease of application, the speed and performance, and more. See your Polyken representative or call the Polyken tape coating distributor near you. Or simply write Polyken, 309 West Jackson Blvd., Chicago 6, Ill.

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THE MODERN WAY

Polyken®

EXPERIENCED IN PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division

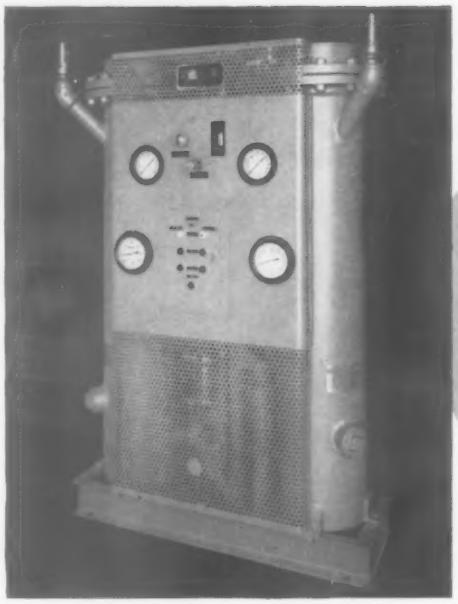
KEMP ORIAD DESICCANT DRYERS

stop moisture best, cost less 3 ways!

1 Complete reactivation
An exclusive 3-zone embedded-heater design gives every KEMP ORIAD DESICCANT DRYER unmatched extra-drying power. Reactivation is always complete and uniform in *any* drying process of air, gases or liquids, assuring maximum desiccant capacity—minimum dew-point performance.

2 Perfect temperature control Heat input is conserved by thermostatic control . . . ideal temperatures are maintained for the highest operating efficiency at the lowest operating costs. An alarm system guards the entire network.

3 Full automatic operation A simple setting of the program timer, and everything is automatically regulated. Drying results with the least pressure loss, lowest operation and maintenance cost. For further details, write for Bulletin D-103 . . . or call your local Kemp Man listed in the Chemical Engineering Catalog.



It always pays to come to

KEMP
OF BALTIMORE

THE C. M. KEMP MANUFACTURING CO.
405 E. Oliver Street • Baltimore 2, Maryland

General oil field contractor says:

"BANTAM gets in there and digs where going is hard"

"Fast and smooth . . . economical to run . . . doesn't give me any trouble"—good reasons why owner S. C. Hawthorne of the Hawthorne Oilfield Const. Co., Beaumont, Texas, bought his second BANTAM C-350 just two weeks after the first!

BANTAM's big-rig features and exclusive engineering advantages enable Hawthorne to get in and dig where the going is rough—and to do the job better, faster and at a lower cost than with any other rig in its class. With a dragline bucket, BANTAM digs and backfills drilling mud pits and ditches; and BANTAM loads gravel for roads, and loads and unloads drilling equipment and pipe.

Increased capacity, greater power, faster line speeds and added flexibility are benefits gained from whatever BANTAM you choose. With 11 quick-change attachments, your BANTAM is ready to work anywhere, at any job. For example, you can add BANTAM's long-boom back hoe for digging depths to 18′10″—greatest trenching production in its class. And more than 25 optional features let you equip your BANTAM to fit any specific job need.

Get all the facts on the entire BANTAM line; the C-350 crawler, the T-350 carrier-mounted and the CR-350 self-propelled models. See your BANTAM distributor and get the facts that will prove BANTAM's superiority in speed and savings over any other rig in its class.

PC-260

SCHIELD Bantam Co.

243 Park Street, Waverly, Iowa

World's largest producer of truck crane-excavators

BANTAM C-350 long crawler with long-boom back hoe digs an 18′, smooth-wall trench for pipeline in tough clay. There's no "digging in" with a BANTAM back hoe . . . it's unequaled for high-speed production!

ARMOUR FUEL OIL ADDITIVES –

How they protect against sludge from refinery to furnace

Armolad® additives, Armour's furnace-oil stabilizers, are gaining wide acceptance as highly economical and effective sludge inhibitors. Using Armolads, refiners can stop worrying about additives that lose effectiveness while in transit or storage.

Fuel oil additives are subject to various conditions which can reduce their sludge-inhibiting properties. Major causes are: incompatibility with other additives, reaction with fuel contaminants themselves, and the presence of water—particularly in barges and storage tanks—which causes "leaching." Maintaining the effectiveness of the additive can only be achieved by increasing the concentration, which in turn raises costs unnecessarily.

Refiners using Armolads have found they are extremely resistant to water extraction, compatible with most other additives, help eliminate hazing, and will not react with fuel contaminants.

In addition, when fuel oil containing Armolads is pumped through the lines, monomolecular adsorption places a thin coating of the additive on the surfaces. This film offers resistance to corrosive action.

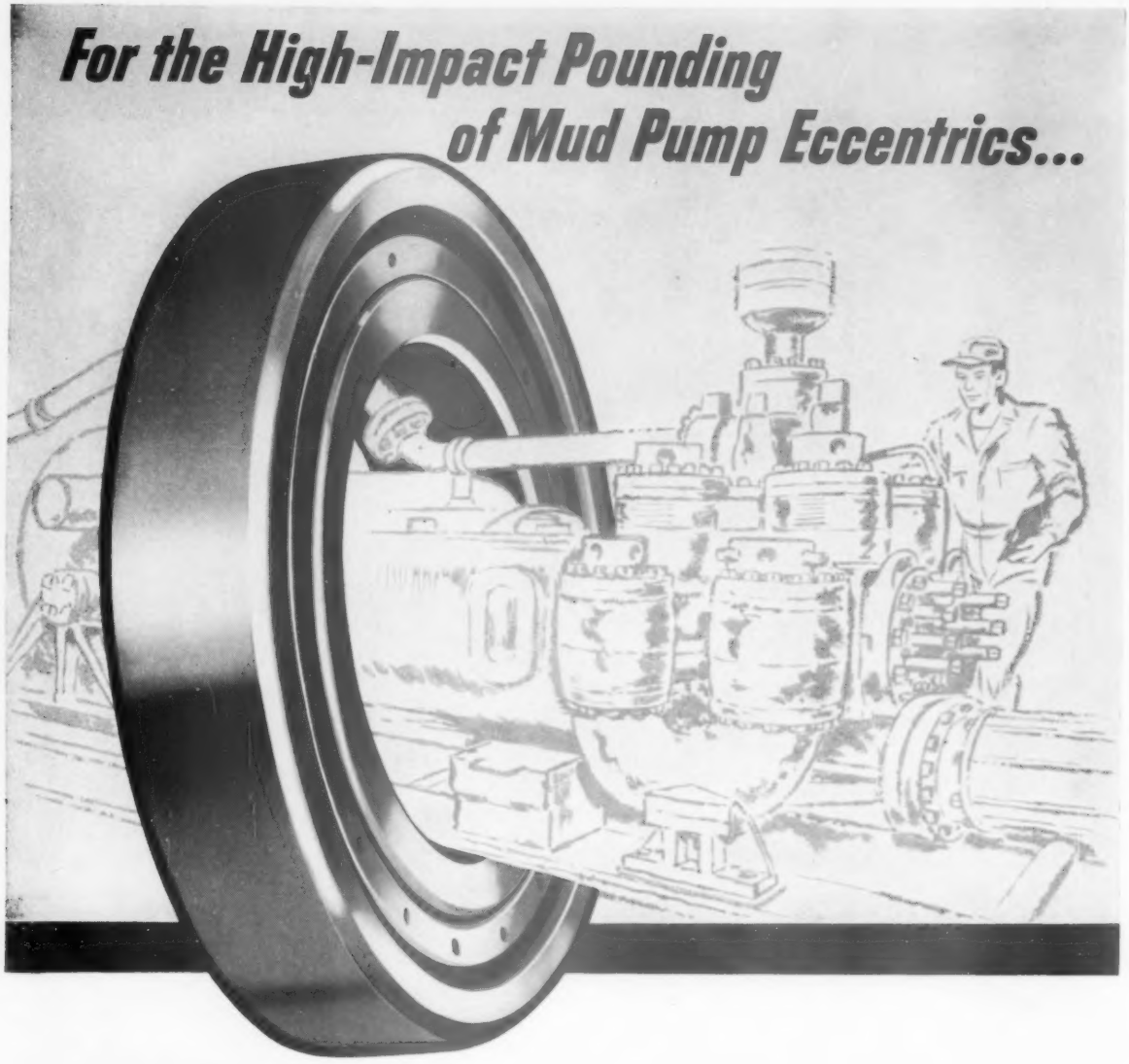
Armolads are available in several different formulations. Each has been found to suit the special needs of specific crude stocks. Additional information on these additives and their use is available by writing for the new booklet "Armolads."

Armour Industrial Chemical Company

© *Division of Armour and Company*

110 NORH WACKER DRIVE • CHICAGO 6, ILLINOIS

For the High-Impact Pounding of Mud Pump Eccentrics...



ROLLWAY MAXIMUM BEARINGS

Repeated high-impact loading puts mud pump eccentric bearings to a gruelling test. But Rollway Maximum Roller Bearings stand up. Their crowned solid cylindrical rollers distribute shock loads more evenly . . . increasing the life of rollers and races alike.

Rollube retainers—land-riding or roller-riding—offer better boundary lubrication to discourage skidding at low speeds. With twice the tensile strength and twice the permissible elongation of bronze retainers, closer tolerances between rollers and separators are possible, keeping misalignment and skew to a lower minimum.

In mud pumps . . . or *wherever* incessant pounding puts a premium on durability . . . specify Rollway Maximum Bearings . . . with Rollube® retainers.

Types for Every TOUGH SPOT

Transmissions • Blowout Preventers
Deep Well Pumps • Cat Heads
Speed Reducers • Traveling Blocks
Crown Blocks • Mud Pumps • Swivels
Walking Beams • Pitmans

ROLLWAY®
BEARINGS
COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

ENGINEERING OFFICES: Syracuse • Boston • Chicago • Detroit • Toronto • Pittsburgh • Cleveland • Seattle • Houston • Philadelphia • LosAngeles • SanFrancisco

FIELD REPORT

FLOOD: New Harmony Unit

OPERATOR: Superior Oil Company

PUMPS: 4 Aldrich Quintuplex

FLOODING STARTED: May, 1957

EXPERIENCE TO DATE: Pumps continuously deliver mixture of fresh and produced water to two formations — 16,000 bbl/day at 1,450 psi.

Customer reports: "Aldrich pumps were selected because previous experience plus new improvements indicated that they better fulfilled our requirements.

"Pumps handling fresh water only have not been repacked since operation began thirty months ago."

Field parts stock available in Carmi, Ill.; Calgary; Casper, Wyoming; Charleston, W. Va.; Houston; Los Angeles; Odessa and Tulsa. For further information, write the ALDRICH PUMP COMPANY, 9 Gordon Street, Allentown, Pa.

the tough pumping problems go to ALDRICH

Quick quiz tells whether you're paying more than you need for Gas Distribution Pressure Recorders

YES	NO		
☐	☐	Can you get easy-to-read 12" charts without paying extra?	from Foxboro you can!
☐	☐	Can you get a fully weatherproof case without paying extra?	from Foxboro you can!
☐	☐	Can you get a 100% submersible case for flooded areas?	from Foxboro you can!
☐	☐	Can you get one standard recorder for both permanent and portable applications?	from Foxboro you can!

A check in the "NO" column means your Foxboro field engineer can save you money —why not call him? The Foxboro Company, 603 Neponset Ave., Foxboro, Mass.

FOXBORO
REG. U.S. PAT. OFF.

• The Skelly Oil Company kept the area around these butane-propane storage tanks completely free of weeds for a whole season by spraying the ground with Du Pont "Telvar".

Get season-long control of fire-hazardous weeds —spray once with a Du Pont Weed Killer

No fire hazard here from weeds. No expensive or difficult weed-control program, either. Just a simple weed-control maintenance program with a Du Pont weed killer kept the area around these storage tanks clean. One spraying of Du Pont "Telvar" monuron or "Karmex" diuron weed killers provides safe, economical weed control around refineries, storage tanks, pipelines and producing fields for a season or longer. Fire hazards are eliminated.

Five-year records of several petroleum companies show that Du Pont "Telvar" and "Karmex" cut weed-control budgets from 50 to 75%. "Telvar" and "Karmex" are non-flammable, non-volatile, non-corrosive and low in toxicity to man and animals. Contact Du Pont for information on which weed killer is best suited to your soil type and moisture conditions—write Du Pont, 2543 Nemours Bldg., Wilmington 98, Delaware; in Canada: Du Pont of Canada Ltd., P. O. Box 660, Montreal, Quebec.

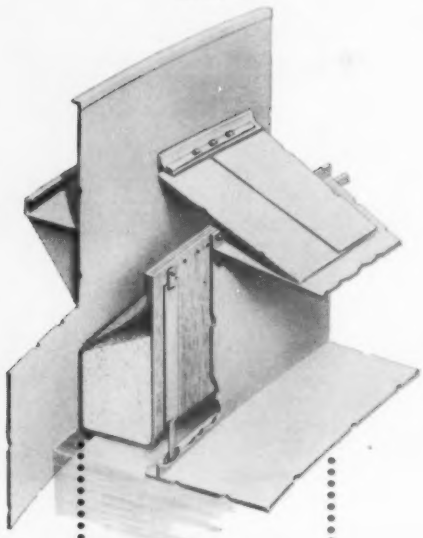
On all chemicals, always follow label instructions and warnings carefully.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Weed and Brush Killers

TELVAR® monuron weed killer · **KARMEX®** diuron weed killer · **AMMATE® X** weed and brush killer · **TRYSBEN® 200** weed killer · **DYBAR®** fenuron weed and brush killer

FIRST solid cushion seal



When General American developed EverSeal, first solid cushion seal for floating roofs, we wanted a seal that would have these advantages:

1. Simplicity of design, no moving parts, nothing to corrode
2. Permanent, indestructible sealing qualities—no gas or liquid to leak
3. Complete protection of coated tank walls from scuffing or gouging
4. A tough, pliable envelope that would withstand abrasion; ride without damage over projections on the shell
5. Ease of repair or replacement, without taking tank out of service
6. Maximum protection against evaporation loss
7. Full protection of oxygen-sensitive stocks
8. No build-up of vapors in the seal area

EverSeal is the *first* solid cushion seal to meet *all* these requirements. It is made of trapezoidal urethane foam cushions enclosed in a tough, scuff-proof envelope of Buna "N" synthetic rubber and polyvinyl chloride plastic.

EverSeal is almost impossible to damage, always provides a safe and complete seal for every floating roof.

Write or phone your nearest General American office for complete information.

It pays to plan with General American.

EverSeal*

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by General American

Plate & Welding Division

GENERAL AMERICAN TRANSPORTATION CORPORATION

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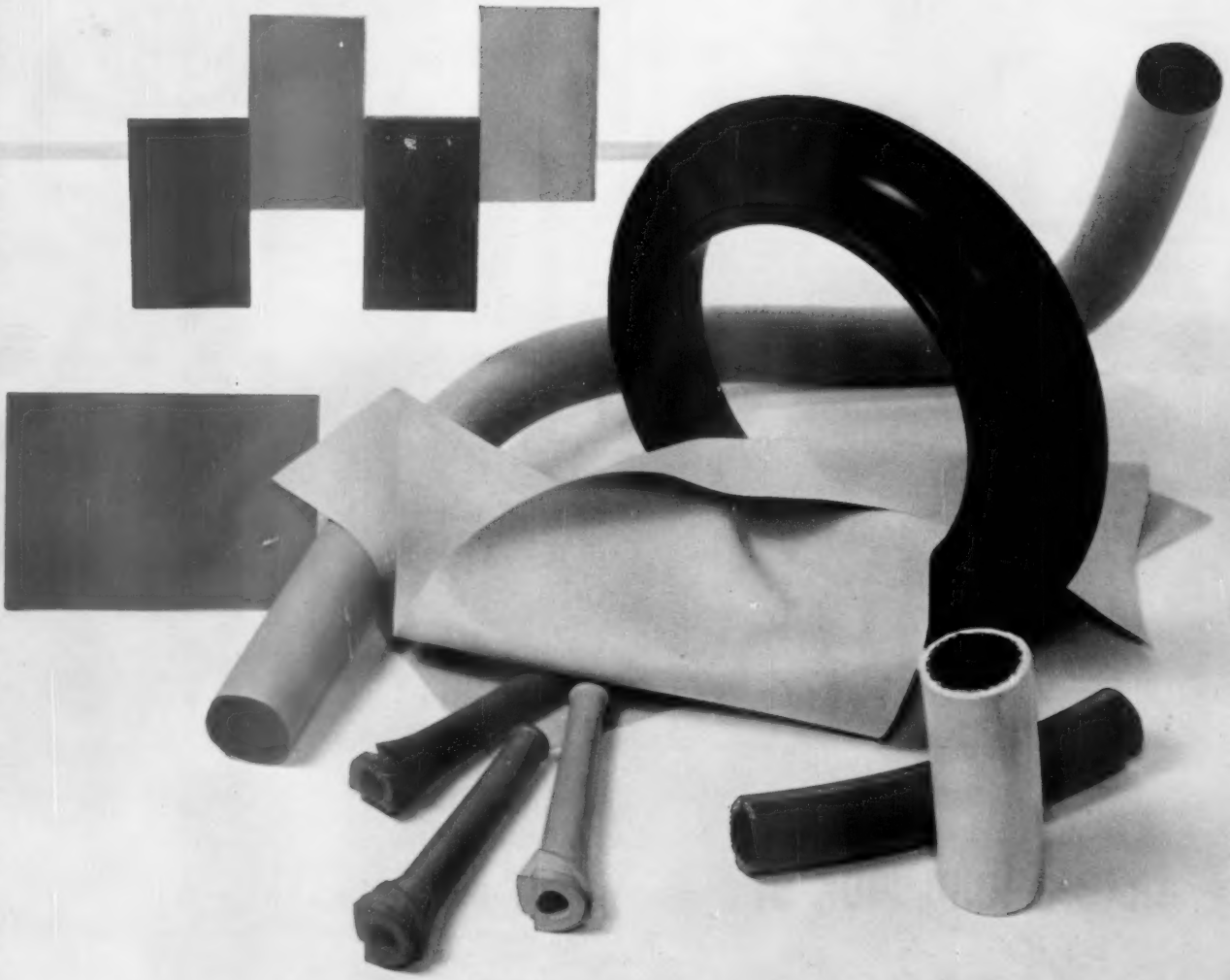
Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



...tough, oil-proof, weather-proof and **colorful, too!**

The samples above should begin to give you some idea of the endless color possibilities in ozone-resistant rubber products made of new PARACRIL® OZO. Now you can give your product color that *sells*... color that identifies for coding wire and cable jacketing... color that blends or *contrasts*... color that works in a hundred ways. And you can give your product other superior properties, too.

Along with color, new weather-resistant PARACRIL OZO gives you a combination of high abrasion resistance, oil resistance, flex life and other valuable rubber properties far surpassing conventional weather-resistant rubbers.

Cast a new eye on the rubber product you make or buy. See the difference color makes. See your Naugatuck Chemical Representative or write the address below for full information on PARACRIL OZO and the advantages it offers.

Naugatuck Chemical

Division of United States Rubber Company Dept. A Elm Street Naugatuck, Connecticut

US RUBBER

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N.Y.

If distance is your problem

take a long look at *Lenkurt* carrier

ALL YOUR
COMMUNICATIONS NEEDS
FROM ONE
DEPENDABLE SOURCE

Lenkurt Type 32E Carrier Equipment is the most economical and efficient means of adding long-haul communications channels to existing wire lines.

By using single sideband suppressed carrier transmission and automatic pilot control, reliable communications under the most adverse weather conditions can be achieved over almost any distance.

Type 32E terminals are equipped with either 3 or 4 channels in the 3- to 35-kc range, and can be applied over v-f circuits. System levels and frequencies of the 3-channel equipment coordinate with those used in Western Electric Type C carrier units.

The AE-Lenkurt team of telephone engineers is equipped to handle as little or as much of the planning and installation as you wish. And AE will provide "follow-thru" service *for the life of the equipment*.

For full information on the Lenkurt Type 32E or companion equipment, call your Automatic Electric representative, or write the Director, Petroleum Sales, Automatic Electric Sales Corporation, Northlake, Illinois.

AUTOMATIC ELECTRIC

Subsidiary of

GENERAL TELEPHONE & ELECTRONICS

GENERAL SYSTEM

YOU NAME THE MUD SPERSENE THINS IT.....

	Weight—lb./gal.	Viscosity—sec./qt.	Gel Strength—Initial/10 min. lb./100 sq. ft.	Fluid Loss—cc.
Gyp mud	19.0	63	0-3	3.9
Lime mud	12.7	53	0-0	5.0
Saturated salt mud	15.0	64	0-4	2.8
Sea water mud	10.8	40	1-4	7.4

The chart tells the story. Based on mud reports of actual drilling wells, it gives conclusive evidence that Spersene® controls viscosity and gel strengths in different types of drilling fluids. The facts prove that Spersene is highly effective in gyp, lime, and salty muds.

Spersene permits the use of high weight gyp muds for deep drilling. The low alkalinity of gyp-Spersene muds improves stability at high temperatures. And, Spersene is soluble in fresh and **salt** water.

Spersene is one more tool developed by Magcobar Technology. The Magcobar mud engineer knows Spersene, knows how to use it right for highest performance. He can help you plan your drilling program with Spersene for maximum economy.

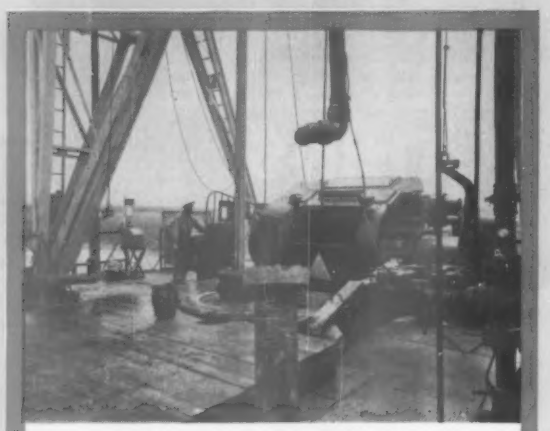
So, wherever you drill, begin planning with Magcobar. You'll find that Magcobar Technology combines the finest engineering skills with high performance products to avoid costly trouble in drilling to let you drill at the lowest cost per foot every foot of the way.

Magcobar
Complete
DRILLING MUD SERVICE

DRESSER INDUSTRIES, INC.
OIL • GAS • CHEMICAL
ELECTRONIC • INDUSTRIAL

MAGNET COVE BARIUM CORP.
HOUSTON

Well Done
With Magcobar
Technology



142 ft. cantilever mast and 7-sheave traveling block can string 14 lines.

Drawworks and 1000 and 1250 HP mud pumps are powered by 3300 HP.

"1965 LOOK" IN OIL RIGS

...as modern driller fights obsolescence with years-ahead design

Here's a challenge: to design an oil rig tailored to today's needs and competition — yet capable of handling the drilling demands anticipated in 5 years.

Power Rig Drilling Company, Inc., Lafayette, La., answered that challenge with its No. 10 Rig which incorporates the specifications of B. R. Littlefield, company president.

No. 10 is competitive in today's 12,000′ to 17,000′ drilling range and is also capable of drilling 25,000′ to answer tomorrow's needs.

To further fight costs of operation, Power Rig Drilling Company equipped No. 10 with Yellow Strand "POWERSTEEL" Rotary Drilling Line. They used a tailored cut-off plan designed for an 89′ cut-off per cut. At last report, 5,000′ of "POWERSTEEL" 1⅜" line had averaged 20.8 ton miles per foot of rope and still had a reserve of 1,495′ to go. Because of such service experience, this contractor has standardized on "POWERSTEEL" for all his rigs. Your records will prove the difference, too. See your Yellow Strand distributor soon!

Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.

Distributed in the Mid-Continent and West Coast Oil & Gas Fields by:
Continental-Emsco Company

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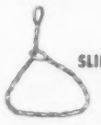
McJunkin Corporation and
Central Oil Field Supply

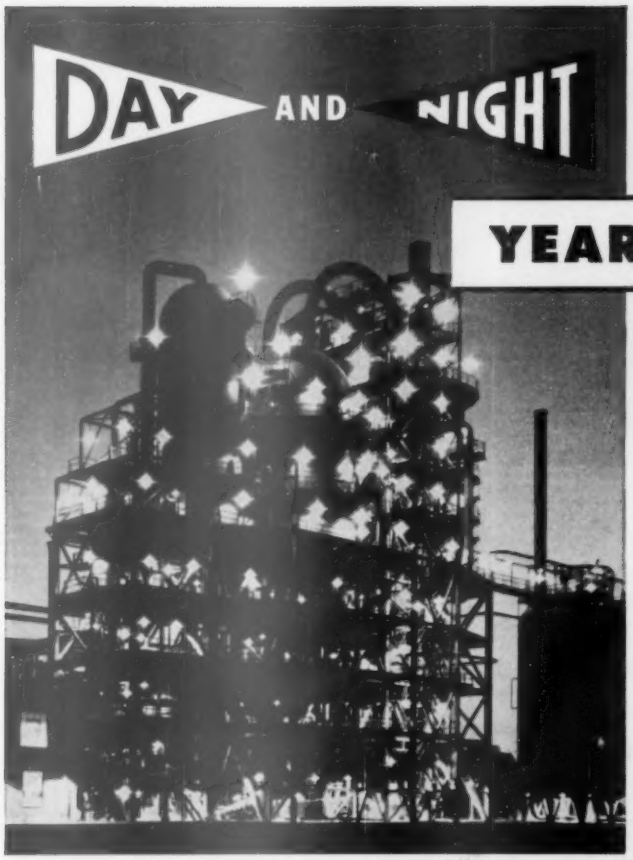
Yellow Strand®

WIRE ROPE



SLINGS

CLIPS



YEAR-IN, YEAR-OUT

always DEPENDABLE

LimiTorque
VALVE CONTROLS

Round the clock, dependable service has been performed by LimiTorque in Refineries and High Pressure Oil and Gas Transmission Lines for a period of 27 years . . . in Canada, Alaska, Venezuela, the Middle East, Sumatra, Sahara, Mexico; all over Continental Europe, and of course, throughout the United States.

Faithful, Dependable Valve Operating Service is the big factor that has made LimiTorque famous—and it is the reason why LimiTorque is the most widely used Valve Operator in the World.

LimiTorque is available in numerous types and variations . . . all "custom built" to do the exact job you require . . . Speeds of operation can be varied over a wide range, even to the provision of two speeds in one direction of travel—and Electrical Control Equipment, such as reversing starters, relays, transformers, etc. may be included, to make a complete operating "package".

Regardless of whether valves are to be automatically operated indoors or outdoors—in sub-zero or elevated temperatures —under snowy, rainy, dusty, or bad fume conditions, there's an exact type and size of LimiTorque to meet your valve operating requirements.

Consult your Valve Manufacturer, or your nearest LimiTorque Sales Engineering Office . . . and remember, there are 27 years of continuous designing and manufacturing experience back of LimiTorque.

Send for Catalog L-550, and please use your Business Letterhead.

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LimiTorque®

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INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID AGITATORS • FLEXIBLE COUPLINGS

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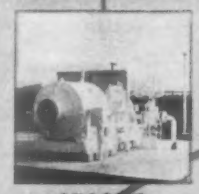
Union Centralized Transport Control pays

LOS ANGELES CONTROLLING OFFICE—The heart of the whole operation is in Los Angeles where one man at the control console can supervise the operation of four unattended pump stations 643 to 804 miles away. The operator has complete information before him showing conditions all along the line.

PHOENIX
Output Terminal

TUCSON
Output Terminal



APACHE
Unattended Booster Pump Station

REMOTE CONTROL—Either pumping unit at any one of the four booster stations can be started or stopped from Los Angeles. The sequence in opening and closing valves and starting and stopping pumps is all handled automatically and correctly by the control system.

off for Southern Pacific Pipe Lines

Push a button in Los Angeles

and four pump stations throb into action out on the desert over 600 miles away

Union Switch & Signal equipment controls operating sequence and telemeters operation of 33,000 bbl/day products line

FLEXIBILITY and fail-safe operation are the keynotes of the new pipeline system operated by Southern Pacific Pipe Lines, Inc. The line is used to transport refined products such as gasoline, jet fuel, diesel oil, etc., from El Paso, Texas, to Tucson and Phoenix, Arizona. All Centralized Transport Control equipment for four unattended booster stations was supplied by Union Switch & Signal.

REMOTE or LOCAL: All four booster stations are normally controlled from Los Angeles. Any station can be controlled locally, when desired. In any case, continuous pressure and suction readings are displayed on the console at Los Angeles and automatically recorded every fifteen minutes by an automatic typewriter. Any malfunction, at any point in the system, is indicated on the console. The equipment affected is shut down automatically and cannot be started again until the trouble has been cleared.

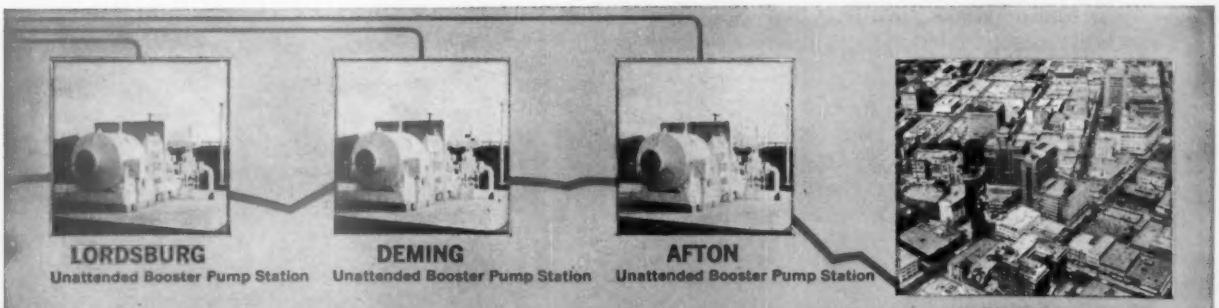
COMMUNICATION: Four telegraphic-type communications lines, owned by Southern Pacific, are used to transmit control codes to the stations and telemetered information back to Los Angeles. Each line serves one station. An additional commercial communications line serves as a stand-by for all four stations. Signals are coded to prevent noise or interference from causing faulty operation or indication.

MAXIMUM EFFICIENCY: The Centralized Control system, designed and installed by Union Switch & Signal Division of Westinghouse Air Brake Company, cuts down the chance for expensive error. It keeps the Southern Pacific Scheduling Department in Los Angeles informed, at all times, of exactly what is happening in the field. It speeds operation, adds security and reliability.

Union Switch & Signal has designed many successful custom systems for pipeline companies. And now out of that experience, it has developed standardized central control systems that cut costs, add flexibility, and save space, as well as making pipeline control extremely reliable.

"Pioneers in Push-Button Science"

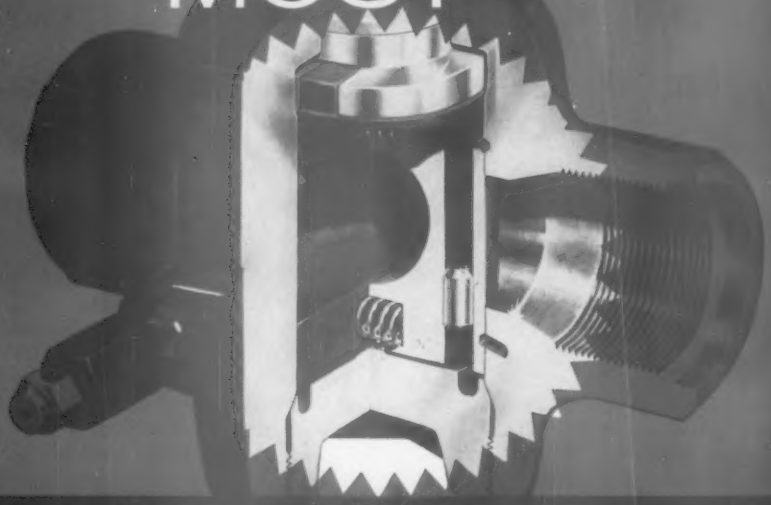
UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE COMPANY
PITTSBURGH 18, PENNSYLVANIA



LOCAL CONTROL—Operation also can be controlled automatically at the pump station. Or the station can be run manually. The choice is up to the local station. But Los Angeles always knows which mode of control is being used and always receives a continuous flow of system information.

THE FUTURE—Southern Pacific Pipe Lines, Inc. can already see opportunity to make this system more automatic and more efficient. They plan, in time, to be able to let stations adjust automatically to proper unit operation when an upstream or downstream station goes off the line.

GET THE MOST



THE MISSION VALVE THINKS FOR ITSELF

TO SEAL AUTOMATICALLY

Not only is the Mission Valve always ready to seal, but the higher the pressure the tighter the seal. Line pressure forces Mission sealant through two semi-circular grooves around the downstream port, sealing like a plastic packing, to form a gas tight seal. Leaks are stopped *automatically* before they start. **The complete line** of 315 Mission Valves brings the positive advantages of easy opening and tight sealing to practically all valve applications. This wide selection, the Mission Guarantee, and the Mission Renewal Policy combine to make Mission Valves your best buy. Specify Mission and eliminate your valve problems.

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MISSION VALVE AND PUMP CO. *a subsidiary of* MISSION MANUFACTURING CO.
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Audit Bureau of Circulations
Associated Business Publications

They Say—

The Tulsa Case

Dear Sir:

We have not at this moment decided what circulation we will give the editorial ("Oil Is Acquitted—but the Government Stands Indicted," OGJ, Feb. 22, p. 56), but I am confident that we will be calling upon you for reprints.

My congratulations for an outstanding and worthwhile job.

Emerson Smith
Director of Public Information
Continental Oil Co.

Dear Sir:

I consider (the editorial) to be fit condemnation of an interventionist governmental agency. When we add the insults of departments such as this to the injury of FPC, IRS, etc., it begins to look as though the alphabets have absorbed the soup.

Robert B. Woodin
Director, Financial and Public Relations
Delhi-Taylor Oil Corp.

Dear Sir:

Congratulations to your chief editorial writer on "indicting" the bureaucrats for attempting to "smear business."

W. L. Horner
Jett Drilling Co., Inc.

GREATLY APPRECIATE YOUR SPLENDID EDITORIAL FEB. 22. ASSURE YOU IT WILL BE GIVEN BROAD DISTRIBUTION THROUGHOUT INDUSTRY.

KERRYN KING
Vice President
Texaco Inc.

Dear Sir:

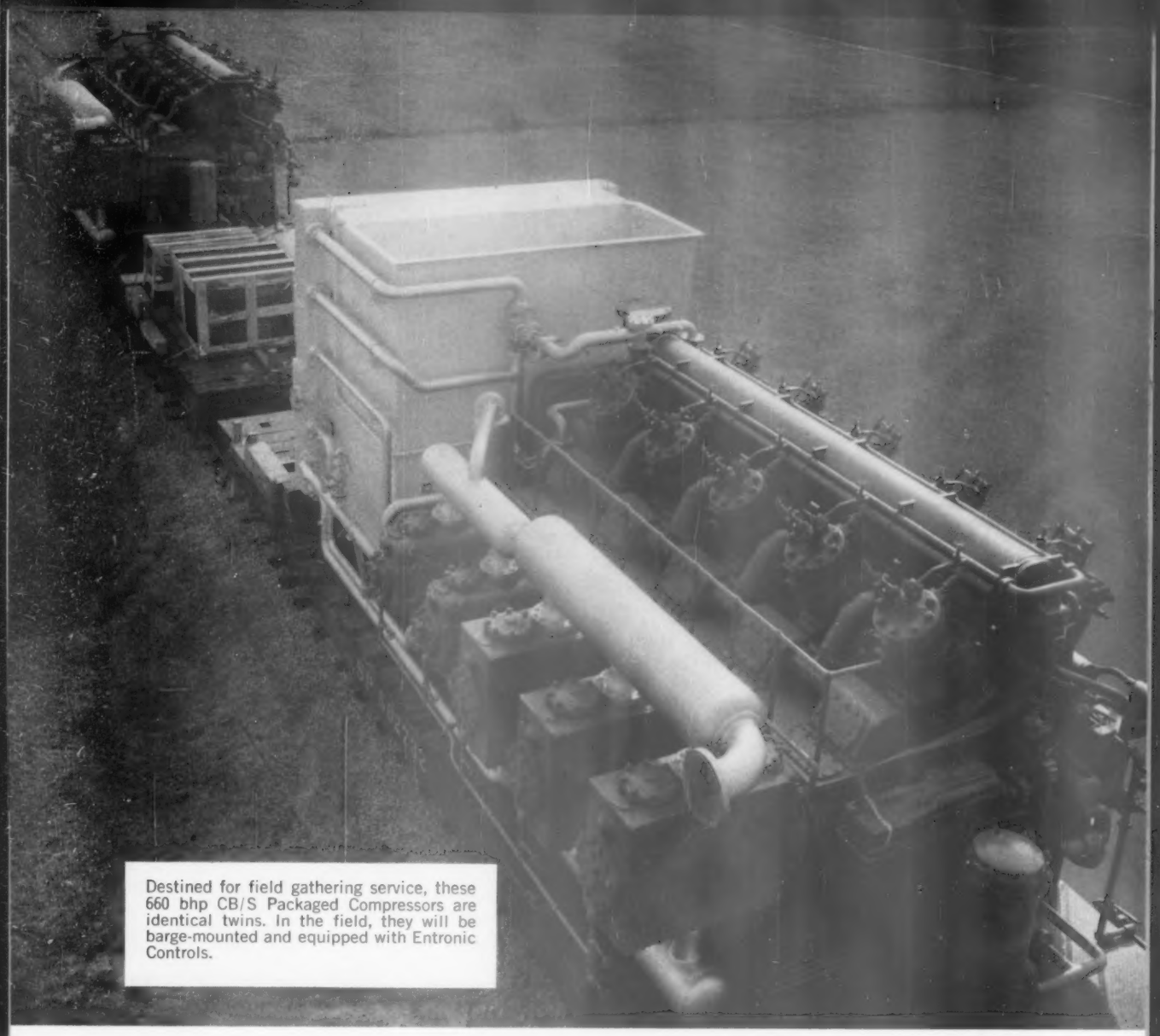
The Journal's editorial is very well done and certainly strikes home at the basic problem—that "the Government is blind to the facts of business life."

T. C. Veale
Assistant Director of Public Relations
Atlantic Refining Co.

Dear Sir:

Please accept my compliments on the excellent background review upon which conclusions in your editorial were predicted.

We are presently involved in an



Destined for field gathering service, these 660 bhp CB/S Packaged Compressors are identical twins. In the field, they will be barge-mounted and equipped with Entronic Controls.

Building packaged compressors is our business . . . our only business. This single objective is the reason CB/S Packaged Compressors are more advanced in design . . . more efficient in the field.

CB/S

PACKAGED COMPRESSORS

CB/S

C-B SOUTHERN, INC., P. O. BOX 19267, HOUSTON 24, TEXAS

A subsidiary of The Cooper-Bessemer Corporation.

antitrust investigation. In my opinion, what is happening is that the Democratic majority of Congress is putting pressure on the U. S. Department of Justice to be stern with business and thereby alienate from the Republican party its long-standing support from business generally.

It is good politics, I suppose, but at a high cost to both Government and industry.

R. L. Tollett
President
Cosden Petroleum Corp.

Dear Sir:

I agree with you completely that this case requires all the publicity that can be obtained. You might like to know that we made strong efforts to accomplish this goal, not so much with the trade press as with public media.

One of our people personally contacted editors of New York papers, the news magazines, and general business publications. Naturally, we sent material to the Chicago papers (and were very gratified to see an excellent editorial in the Tribune), and also sent background resumés of the case to editorial writers of newspapers in every city in the midwest.

Results have been pretty good so far, and we expect they will continue.

Congratulations on your splendid editorial.

Don Campbell
Director of Public Relations
Standard Oil Co. (Ind.)

Dear Sir:

It was a splendid editorial and should be given the widest of publicity.

It is indeed unfortunate that the industry does not use the same amount of energy and intelligence to correct its present marketing practices that it used to resist the Government's claim.

Roland V. Rodman
President
Anderson-Prichard Oil Corp.

Dear Sir:

My compliments. Your remarks will enjoy the endorsement of the entire industry.

Harry A. Jackson
President
American Petrofina, Inc.

Dear Sir:

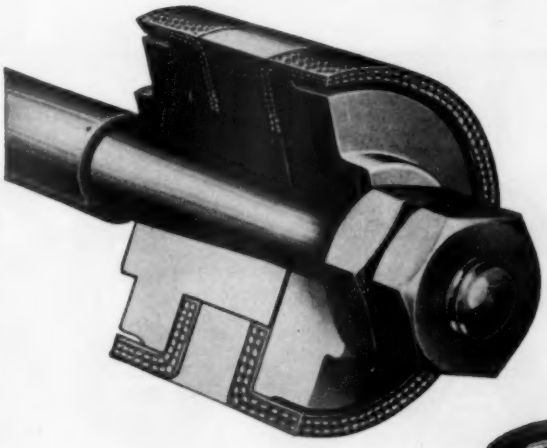
Your editorial analysis is a challenging indictment of a bureaucracy which simply doesn't seem to understand the American business system.

Profit is, of course, the motive of business—and jobs and wages and growth and stability and national

LESS FLUID SLIPPAGE!

LESS DOWNTIME!

GREATER EFFICIENCY!



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...In hydraulic and pneumatic mechanisms, reciprocating pumps

Darcova 45° Bevel Type Pumcup

THE BIG DIFFERENCE you'll find in Darcova Pumcups is that they operate at full efficiency *throughout their entire life.* This means fluid slippage is virtually eliminated.

And because fewer replacements are necessary, you have less downtime. Users report that Pumcups *outlast ordinary packings at least 3 to 1!*

Pumcups are available in three textures—hard, medium and soft. Also in regular or 100% nylon composition. Sizes range from ¾" to 20". For all the facts on Pumcups, write for Bulletin 5903.

DARLING VALVE & MANUFACTURING CO.
Williamsport 1, Pa.

DARCOVA
THE ORIGINAL COMPOSITION CUP

TRADE MARK PUMCUPS

with efficient, economical Davison Silica Gel

Hydrocarbon recovery from the dehydration of natural gas can pay your gas drying costs. The large pore volume of Davison Silica Gel attains recovery efficiencies up to 95%. For example, a unit operating on 30 to 120 minute cycles at 100° F. can recover up to three gallons of butane-plus per 100 lbs. of silica gel.

Specify Davison Silica Gel in your hydrocarbon recovery unit. Write Dept. BA03 for complete information.

Department-BA03
W.R. GRACE & CO.
DAVISON CHEMICAL DIVISION
BALTIMORE 3, MARYLAND

greatness are the natural results of freedom of enterprise.

The settlement of this case is a great gain for all business freedom and the Government itself will quickly gain strength if it will learn to disassociate economic facts from political persecution.

Luther Williams
Manager, Public Relations Department
Sunray Mid-Continent Oil Co.
Tulsa

Dear Sir:

Hearty commendations and congratulations to The Oil and Gas Journal. The four questions you raised about the conduct and integrity of the Government in this antitrust case are well stated and very much to the point.

The oil industry has been made a political football for too many years. Your leadership in this instance will undoubtedly be a strong influence in helping to convert the traditional defensive posture of the oil industry into a more realistic and aggressive fight against governmental interference and unjust accusations.

J. R. Polston
Service Pipe Line Co.
Tulsa

Dear Sir:

I hope you have circulated prints to every member of Congress and other governmental officials—state and national—as well.

The Tulsa vindication should be as widely publicized as possible. With the help of publications like your Journal it may well be that in the future a little more justice will come out of the department of the same name.

Jack F. Gow
Public Relations Manager
Tidewater Oil Co.,
eastern division

Letters to They Say should be addressed to The Editor, The Oil and Gas Journal, Box 1260, Tulsa, Okla.

CALENDAR

MARCH

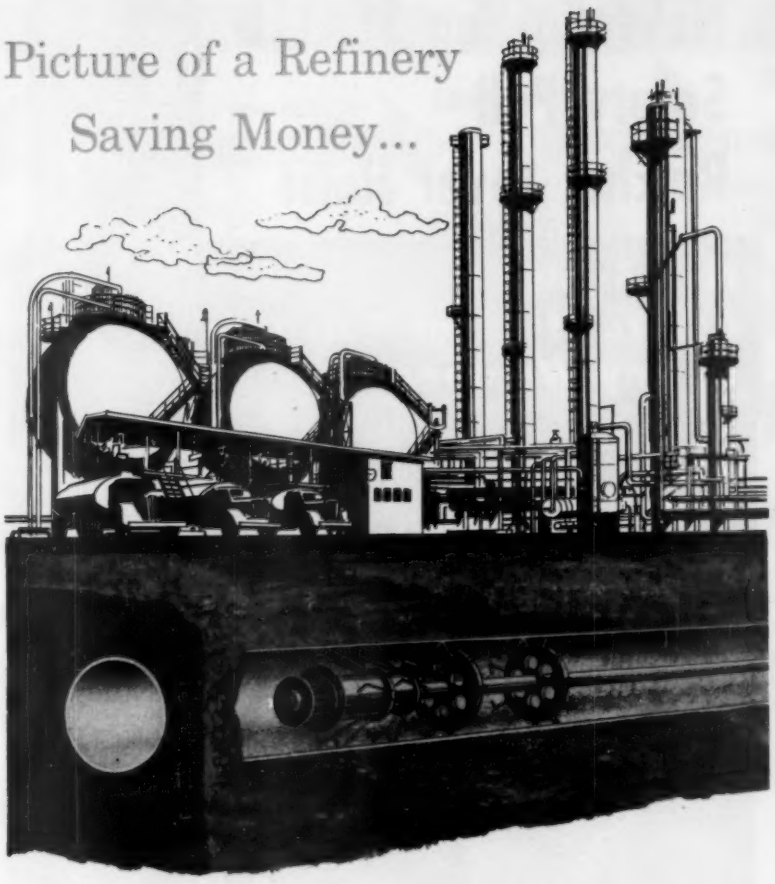
14-18 National Association of Corrosion Engineers, sixteenth annual meeting, Memorial Auditorium, Dallas.

16 Petroleum Equipment Suppliers Association, eastern district membership meeting, Duquesne Club, Pittsburgh.

16-18 American Petroleum Institute, Division of Production, southern district meeting, Hilton Hotel, San Antonio.

17-18 Society of Petroleum Engineers of AIME, Beaumont-Spindletop section, Upper Gulf Coast drilling and production conference, King Edward Hotel, Beaumont, Tex.

18 Natural Gasoline Association of



Spunline Relines Pipe Lines in-place without removing the pipe

Another refinery, it could be in Texas, California or Montana, will soon be enjoying the savings of another rehabilitated pipe line. The flow will increase, the pumping cost will drop and the pipe line will be good as new for at least another quarter of a century.

And traffic will move without interruption or inconvenience to the public.

Spunline® is applicable to pipe lines down to 4" and may be used in cast iron, steel, concrete and wrought iron pipe lines.

Write, wire or phone **PIPE LININGS Inc.**

Subsidiary of American Pipe and Construction Co.

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P.O. Box 457 • Phones: SPruce 5-3273 — TErminal 5-8201
Rail Address, Pacific Electric, Watson, California

NEW Coffing SEALED Safety Pull Ratchet Lever Hoist

Five Seals Assure Efficient Hoisting In Any Weather

Here is a new hoist designed for safe, efficient hoisting in any weather. Loads will not slip because the brake mechanism of the Safety Pull Hoist is permanently sealed in five places against moisture, oils, chemicals and dirt—all common causes of hoist slippage.

The spring-loaded Neoprene seals assure that brake performance will remain constant under all exposure conditions. Another advantage of the sealed brake is that it will not freeze or lock—is always free to lower even after accidental overload.

Safety features include the exclusive Safety Handle which bends to indicate overload. The free chain control is protected so that it will not accidentally trip.

The Safety Pull Hoist is easy to operate. The handle pull to lift rated load requires minimum effort. Load spotting is precise to within a fraction of an inch. Up and down controls are away from operator's hand so he can use shorter leverage for greater speed with light loads. Ball bearing swivel load hook and plated chain are additional features.

Five models, ¾, 1½, 3, 4½ and 6-ton capacities are available. For additional information see your favorite supply store or write for Bulletin ADH-78.

COFFING HOISTS

DUFF-NORTON COMPANY

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COFFING HOISTS

Ratchet Lever • Air
Hand Chain • Electric

DUFF-NORTON

DUFF-NORTON JACKS

Ratchet • Screw
Hydraulic • Worm Gear

America, Oklahoma regional meeting, Biltmore Hotel, Oklahoma City.

18 American Institute of Mining, Metallurgical, and Petroleum Engineers, upper Gulf Coast drilling and production conference, Beaumont, Tex.

21-22 Midwest Gas Association, annual meeting, Hotel St. Paul, St. Paul.

21 University of Texas, school of gas technology, sixth semi-annual term, Kilgore College, Kilgore. Term ends April 29.

23 Petroleum Equipment Suppliers Association, Pacific district annual membership meeting, Ambassador Hotel, Los Angeles.

24-25 New England Gas Association, annual meeting, Hotel Statler-Hilton, Boston.

24-25 American Institute of Mining, Metallurgical, and Petroleum Engineers, petroleum conference on reservoir and production engineering, Tulsa.

25-26 North Texas Oil and Gas Association, thirtieth annual meeting, Kemp Hotel, Wichita Falls, Tex.

28 University of Texas, American Petroleum Institute Division of Transportation, school of pipeline technology, eighth semi-annual term, Lee College, Baytown, Tex. Term ends May 6.

28 University of Texas, American Petroleum Institute Division of Production, institute on automatic production controls, first term, Odessa College, Odessa, Tex. Term ends May 6.

28 Independent Oil Producers and Land Owners Association, Tri-State, annual meeting, Hotel McCurdy, Evansville, Ind.

28-30 Western Petroleum Refiners Association forty-eighth annual meeting, Hilton Hotel, San Antonio, Tex.

29 Petroleum Equipment Suppliers Association, Gulf Coast district membership meeting, Shamrock Hilton Hotel, Houston.

29-31 American Power Conference, annual meeting, Sherman Hotel, Chicago.

30-Apr. 1 American Petroleum Institute, Division of Production, Mid-Continent district meeting, Broadview Hotel, Wichita.

APRIL

3-5 Society of Exploration Geophysicists, annual midwestern regional meeting, Washington-Youree and Captain Shreve hotels, Shreveport, La.

3-8 Engineers Joint Council, sixth nuclear congress, New York.

4-7 Oil Heat Institute of America, annual convention, Park-Sheraton Hotel, New York.

4-7 National oil heat and air-conditioning exposition, Coliseum, New York.

4-8 Society of Automotive Engineers, national aeronautic meeting, Commodore Hotel, New York.

5 Petroleum Equipment Suppliers Association, southern mid-continent district membership meeting, Statler Hilton Hotel, Dallas.

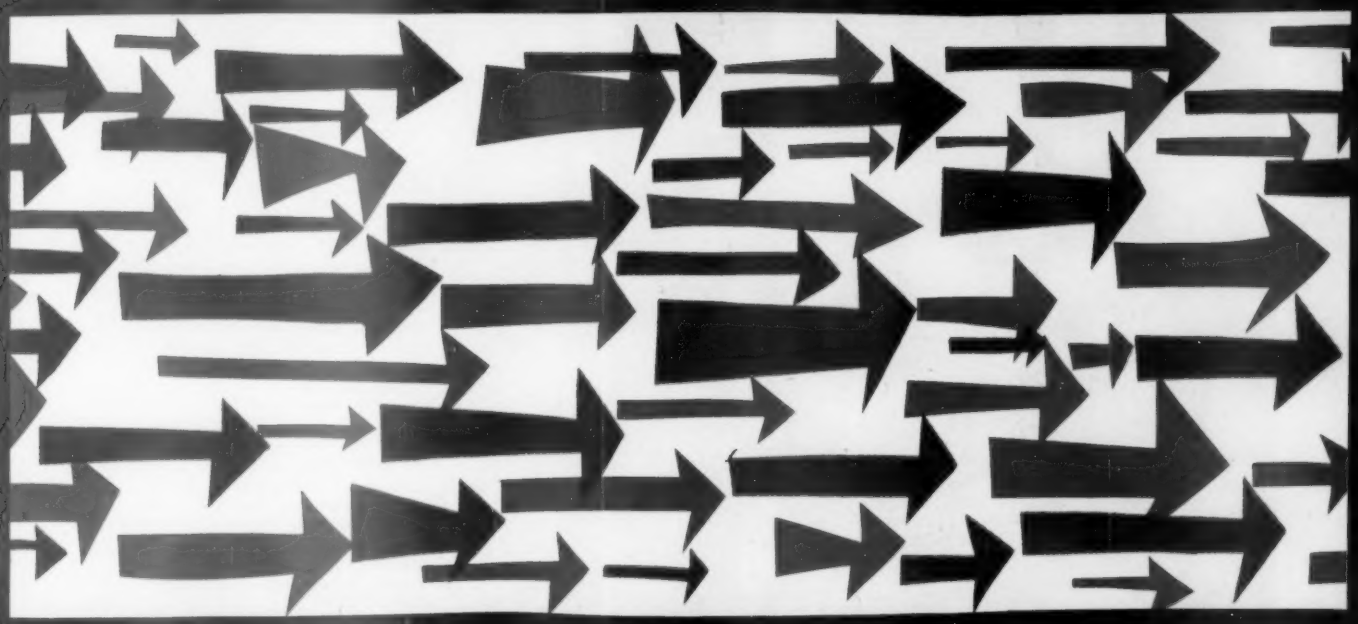
5-6 University of Kansas, eighth annual gas compressor institute, National Guard Armory, Liberal, Kans.

5-7 Instrument Society of America, national chemical and petroleum instrumentation symposium, Rochester, N. Y.

7-8 Rocky Mountain Oil and Gas Association, midyear meeting, Newhouse Hotel, Salt Lake City.

8 Chemical Institute of Canada, rubber chemistry division, annual meeting, Kitchener, Ont.

12-14 Petroleum Industry Electrical Asso-



More pipeline thru-put without adding a single joint

Copon internal pipe coatings smooth the way for increased capacity

Leading transmission companies find that pipelines coated internally with Copon coatings deliver more thru-put . . . and with less compressing costs. Flow tests conducted on Copon-coated lines *prove conclusively* that transmission capacity has been increased. These tests have been conducted jointly with major pipeline companies over the past several years. Results endorse the value of Copon coatings for all types of pipeline systems.

Stretching pipeline capacity is an added bonus for internal coating. Copon coatings are specifically designed to provide maximum corrosion protection, to reduce maintenance costs, and to make possible delivery of cleaner products. Special applications are available for coating dehydrated gas lines, crude and petroleum product lines, salt water or fresh water lines, and oil well tubing and casing.

Ask your nearest Copon Associate for specific information on increased thru-put and valuable line protection. Then specify Copon — get the increased performance your pipeline can give you.

Use Copon to coat submerged or buried lines. Also on individual joints for new construction.

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COSTS GO DOWN, DOWN, DOWN

The Hunt-De Cordova Washover and Recover Cutter has established new all time records for the recovery of tubing and drill pipe from the outside.

For job data sheets that prove it saves time and money write or telephone any Hunt Tool Company office. Or request our Technical Bulletin No. 505 for complete details.

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ciation, Petroleum Electric Supply Association, conference and exhibition, Municipal Auditorium, Kansas City.

15-16 Society of Economic Paleontologists and Mineralogists, Permian Basin section, annual meeting, technical session and field trip, Windsor Hotel, Abilene, Tex.

15-16 Society of Economic Paleontologists and Mineralogists, Pacific section, annual spring field trip, Panoche Hills, San Joaquin Valley, California, and evening meeting, The Hacienda, Fresno, Calif.

19-21 University of Oklahoma, College of Engineering, southwestern gas measurement short course, north campus, University of Oklahoma, Norman.

19-21 American Society of Lubrication Engineers, annual meeting and lubrication exhibit, Netherland Hilton Hotel, Cincinnati.

20 Chemical Institute of Canada, joint meeting, Quebec rubber and plastics group and Montreal section, Queen's Hotel, Montreal.

20-22 American Petroleum Institute, Division of Production, Rocky Mountain district meeting, Gladstone, Henning, and Townsend hotels, Casper, Wyo.

20-22 National Petroleum Association, semiannual meeting, Hotel Cleveland, Cleveland.

21-22 Oklahoma State University, technical conference on heat transfer, Stillwater, Okla.

21-22 Texas Technological College, seventh annual West Texas oil lifting short course, Lubbock, Tex.

24-26 Independent Petroleum Association of America, midyear meeting, Denver Hilton Hotel, Denver.

25-26 American Society of Mechanical Engineers, maintenance and plant engineering conference, Chase-Park Plaza Hotel, St. Louis.

25-27 Southern Gas Association, convention, Buccaneer and Galvez hotels, Galveston.

25-28 American Association of Petroleum Geologists, Society of Economic Paleontologists and Mineralogists annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

25-29 American Welding Society, annual meeting and welding exposition, Los Angeles.

27-29 Natural Gasoline Association of America, annual convention, Rice Hotel, Houston.

28-29 American Petroleum Institute, Division of Transportation, pipeline conference, Mayo Hotel, Tulsa.

28-29 Pacific Coast Gas Association, distribution conference, Benson Hotel, Portland.

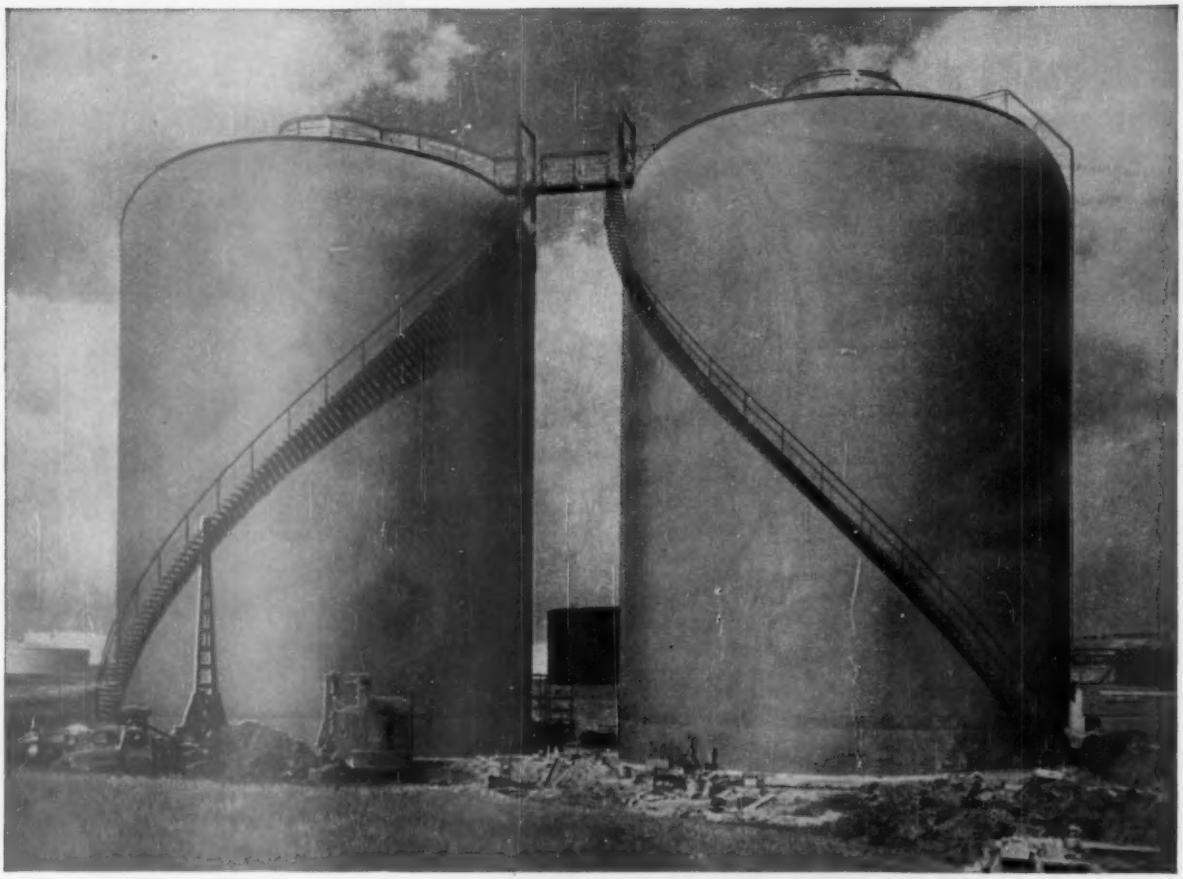
MAY

1-3 Texas Independent Producers and Royalty Owners Association, fourteenth annual membership meeting, Holiday Inn, Carlton and Blackstone Hotels, Tyler, Tex.

1-4 American Petroleum Institute, Division of Transportation, tanker conference, Seaview Country Club, Absecon, N. J.

2-3 Society of Petroleum Engineers of AIME, North Texas section, fourth biennial secondary recovery symposium, Wichita Falls, Tex.

5-6 American Institute of Mining, Metallurgical and Petroleum Engineers, annual joint meeting of Rocky Mountain petroleum sections, Calgary.



Two Beauties for Butadiene

"Cool" is the word for these ellipsoids . . . they're built to store butadiene at just-above freezing temperatures, which in Texas means about 45° below ambient temperature. They're 60 feet in diameter and 62 feet high, with storage capacity of 40,000 barrels each.

Butadiene is a problem child when it comes to storage. Vessels must be cold-storage as well as safety-vaults. Operating in an ambient temperature of 80° F the butadiene liquid in these twin ellipsoids had to be refrigerated to 35°F at 10 psig so that it could be kept "indefinitely."

At higher temperatures butadiene will deteriorate. Four inches of glass fiber insulation help maintain the low storage temperature to guarantee the quality of the butadiene.

It takes a heap of know-how and experience to build tanks that meet such stringent requirements. We are proud to have been given the opportunity to build these two ellipsoids for Hess Terminal at Galena Park, Texas.

For any type of process vessel made of metal plate, consult the Pittsburgh-Des Moines Steel Company.

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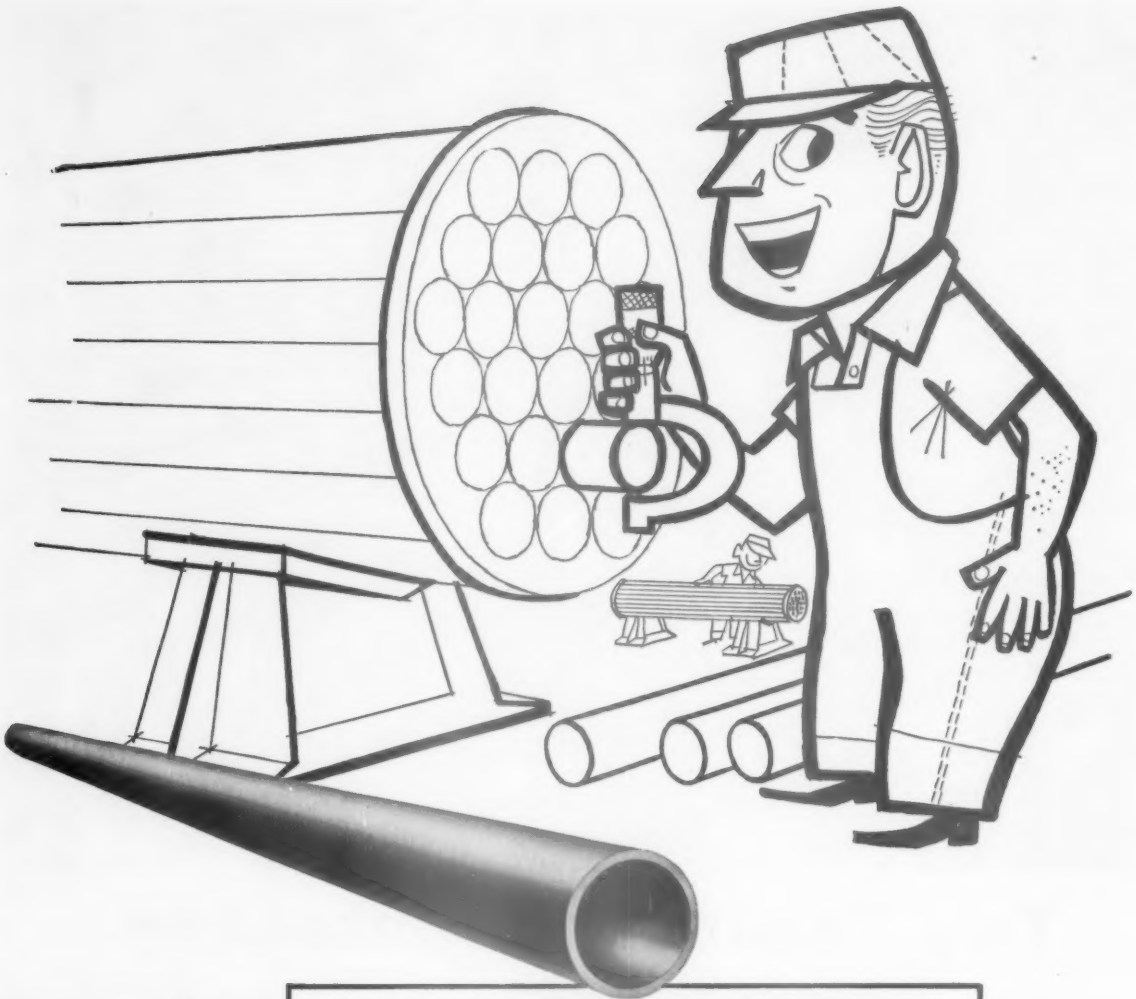

How B&W JOB-MATCHED TUBES meet Heat-Exchanger requirements

With B&W Job-Matched Heat-Exchanger Tubes you get:

- ... tube tolerances and mechanical properties, controlled for ease of fabrication
- ... a wide range of steels to meet any set of operating conditions
- ... a complete range of tube sizes, for any type of heat exchanger

This means ease of fabrication to the heat-exchanger manufacturer — long service life to the heat-exchanger user—and ease of tube replacement to those concerned with maintenance.

For complete information about B&W Job-Matched Heat-Exchanger Tubes call the local B&W District Sales Office or write for Bulletin TB-329. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

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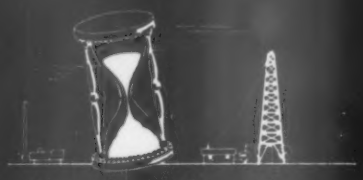
Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals



the Journal said...

50 years ago

March 20, 1910

Seven rigs are running around Fayette, in northwestern Alabama, where Eureka Oil Co. has completed a well flowing 4 M.M.c.f. of gas daily from a 1,300 to 1,400-ft. sand. Drilling outfits are cable tools as the rock is too hard for rotaries. Drillers believe oil will be found some place nearby. Sizable shows have been obtained in earlier mine-test boring.

California's biggest well to date blew in last week with a tremendous roar, and defied all efforts to control its flow before it sanded and choked itself. Drilled by Mays Oil Co. in Midway field, its flow during the first 4 hours was estimated at 50,000 bbl. daily, and then settled to 1,000 bbl. hourly. Total depth is 2,790 ft. Flow through 6-in. horizontal line shot more than 500 ft. from the derrick. It overshot the pit provided to hold the 22°-gravity oil.

25 years ago

March 14, 1935

Oklahoma joins New Mexico as second state to approve and enter an interstate oil compact adopted at a recent governors' conference in Dallas. Favorable action expected soon by Texas and Kansas.

Completion last week in Oklahoma's booming Fitts field, in Pontotoc County, of 63 more wells with daily oil flow averaging more than 3,500 bbl. per well, places this among the potentially largest oil-producing areas of the country.

Discovery of oil production at Monument, 8 miles southwest of Hobbs, stirs new interest in southeastern New Mexico's oil potentialities. Amerada Petroleum Corp.'s discovery well, 1-D State, flows 945 bbl. in 24 hours from 3,929 ft.

10 years ago

March 16, 1950

Standard Oil Co. of California launches multimillion-dollar refinery construction and revamping program. It is designed primarily to aid reduction of California's overproduction of heavy fuel oil. Output of gasolines and intermediate products to be boosted.

Representatives of 35 operators form engineering committee to collect factual data, schedule tests, and analyze reservoir and production conditions in the rapidly spreading Canyon reef fields of Scurry and adjoining counties.

U. S. State Department plans strong action against British ban on oil from dollar sources. Embargo on imports of oil by British-controlled companies proposed. Dollar-sterling controversy grows.

JOURNALLY SPEAKING

The Owls of Oil

IN ONE of those improbable coincidences which bolster the age-old belief that our lives are governed by a guiding, though sometimes capricious, Fate, the same mail brought us two communications about owls.

We wouldn't have given a second thought to either one if we hadn't read them practically simultaneously. And we wouldn't have connected either one with the oil industry if the first document—though signed "Anonymous"—hadn't been pinned to the card of a friend who is in the oil business.

This one was headed "The Story of the Owls in the Tree." It was a fable, and while it didn't mention oil we decided it was not written by Aesop but by some modern-day oil man who reflects the current plaint of lack of leadership in the industry. Here's what it said:

"Once upon a time there was a group of owls. They lived in a special place, high up in a tree that was 100 years old. They talked to each other, and they were very wise.

"Sometimes a sudden storm would shake the tree and disturb the owls. Each of them, being very wise, knew what should be done. Not very much was done, though, because when owls become very wise they do not agree with each other.

"There were many others who lived in the same tree. Not as high as the owls, but the storms disturbed them, too. They also knew that something should be done, and they depended on the wise old owls.

"Things went from bad to worse. There were more storms. The owls talked while the others waited. As before, not very much was done.

"One day some of the owls got together and decided to hire a weatherman so that everyone in the tree would be prepared for the storms. It might have done some good. The weatherman knew the weather, and he knew he was not an owl. But the owls, being very wise, told the weatherman what to do about the weather. And the storms got worse, and the tree came crashing down.

"This is the end of the story of the owls in the tree that could have lived another 100 years."

Obviously the anonymous author of that fable was comparing the 100-year-old oil industry to a tree. And the storms were the periodic market gluts and disastrous price wars brought on by producing and refining more oil than consumers can use. And the weatherman represented market analyses and statistical reports that tell the condition of supply and demand.

And so the wise old owls in the top of the tree could only be the so-called industry leaders, the executives of the larger oil companies.

While we were pondering this picturization of leading oil men as owls who talk wise but act foolish, we picked up a press release from the National Geographic Society and were hit in the face by this headline:

"Owl is short of brains but successful in life."

We picked ourself up off the floor and read on:

"The not-so-wise old owl is a living example that intelligence is not necessarily the key to success.

"Despite its knowing look, the creature has a notably small 'bird brain.' Its perch is low on the IQ totem pole."

We went down the hall for a cup of coffee. We looked out the window to be sure it was daytime and we were at the office. Could it be that the National Geographic Society, too, was thinking of oil executives when it was talking about owls?

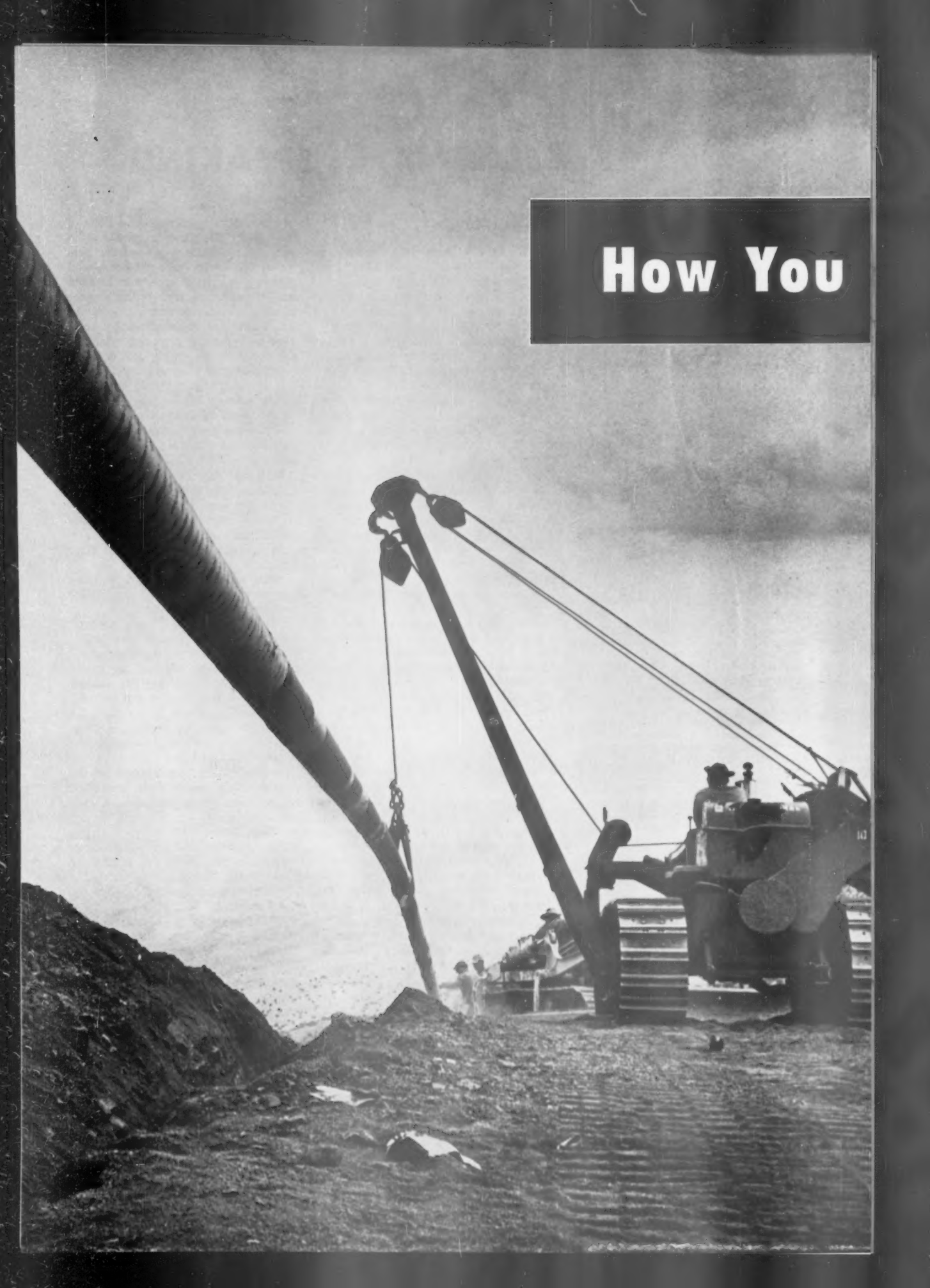
With growing wonderment at the aptness of the analogy, we went back to the press release and spotted such gems as:

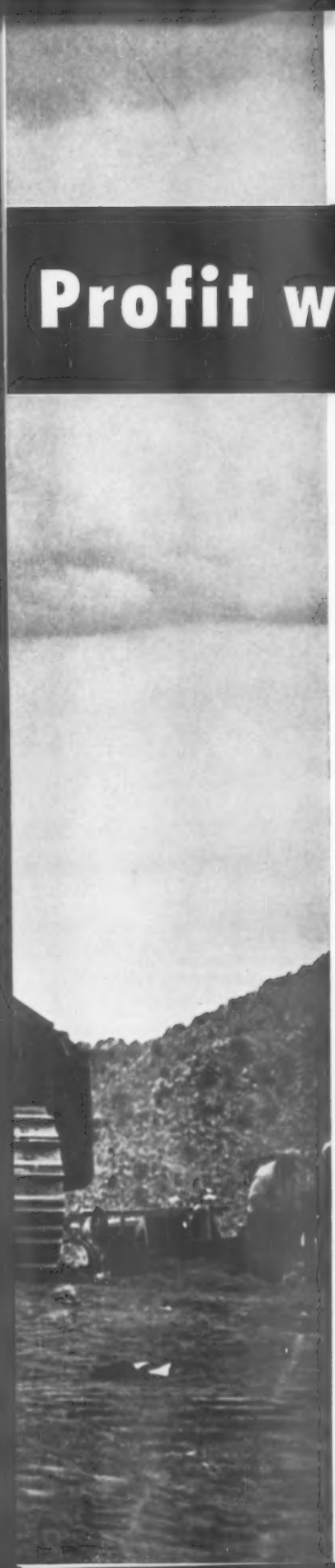
"Owls show little capacity to learn . . . Time and again they crash into the same objects . . . If blocked from taking the easy way around a barrier, they lack initiative to try the other side. . . .

"The outstanding characteristic of the bird is its nocturnal skill . . . Great staring eyes are sensitive to the faintest light . . . large, complex ears pinpoint squeaks and footfalls . . . Like a helicopter, it has the ability to move slowly, to hover . . . it flies silently.

"The owl's reputation is fostered by . . . its eerie cries in the night . . . fiercely solemn look . . . and strange ability to twist its head completely around."

—Henry D. Ralph.


How You



Profit with J&L Electricweld

J&L Electricweld Line Pipe insures fast economical pipe line construction. Uniform high ductility means easier field bending. Lengths are uniformly round. They line up end to end in perfect butt joints with uniform bevels for fast dependable welding. Multiple testing of every length of *J&L Electricweld* is your assurance of better performance during installation and during operations.

(1) After the pipe is welded, the weld area is annealed and subjected to an ultrasonic inspection.

(2) Every length is pressure-tested under the specified A.P.I. or A.S.T.M. hydrostatic test requirement. Pneumatic hammers strike the pipe while it is under pressure to build up pressure surge.

(3) A series of visual inspections is made on every length of *J&L Electricweld.*

(4) Every length of pipe is given a crush test to determine weld strength and steel quality. The test complies with requirements of A.P.I. 5L, 5LX and with A.S.T.M. A-53, A-135 and equivalent specifications.

(5) Both ends of every joint of *J&L Electricweld Line Pipe* receive a magnaflux examination.

J&L Electricweld is available in sizes 6⅝" O.D. through 12¾" O.D.

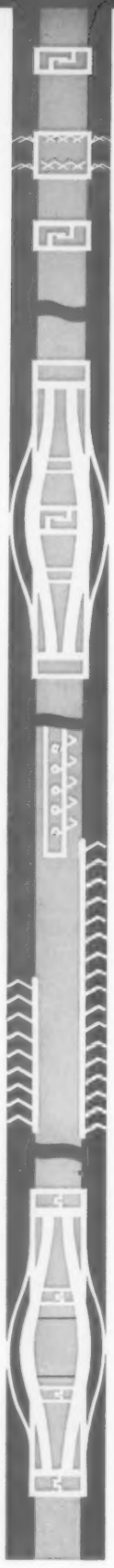
Discover how you can profit by using this high quality pipe in your next line. Call your local J&L Supply man today.

Jones & Laughlin

SUPPLY DIVISION – Tulsa

If it's sold by J&L....
It's the best available

Better Cementing Starts with **CENTERED CASING and a Good BONDING SURFACE**



BAKER CASING CENTRALIZERS assure cementing clearance—no "balling"—no plugged annulus. When running in the hole their "sled-runner" springs do not remove mud cake which can plug the annulus, cause pressure surges, and restrict production. These strong, quality steel springs are securely butt-welded to collars; then pre-set so that they pass tight spots or dog legs and still retain all of their original ability to provide greater centering force. Available in HINGE-LOK or SOLID-RING models, and in all required sizes and types from "slim-hole" to "extended range."

BAKER WALL SCRATCHERS prepare the cementing area for an effective cement bond. They glide down the hole without removing mud cake which can stick the casing, plug the annulus and build up pressure surges. When activated at the cementing area, the undamaged scratcher wires remove mud cake to ensure successful bonding of cement to formation. RECIPROCATING Scratchers (top view) are available in Solid-Ring or Hinge-Lok types with long or short wires as specified. ROTATING Scratchers (below) are furnished in five-foot sections, each with 48 scratching points which readily remove mud cake from the well bore, even under varying clearances.

BAKER HAMMER-LOK STOP RINGS retain scratchers and centralizers positively at the point of installation. You can avoid harmful welding on high-strength casing (such as N-80) and still maintain ample holding force with the new, easy-to-install Hammer-LOK Stop Rings which are quickly installed while the casing is on the rack, or while hanging in the rig. By merely flattening the locking wedge with a hammer, the ring grips the casing so securely that it will resist a vertical force of as much as 35,000 pounds, according to laboratory tests. The effective initial placement of centralizers and scratchers is thus maintained.

BAKER OIL TOOLS, INC. HOUSTON LOS ANGELES NEW YORK

The Baker representative in your area is a primary cementing equipment specialist; call him in advance of your next cementing job.

What it takes to keep gas flowing

NATURAL GAS is still the fastest-growing segment of the fuels industry, but evidence is mounting that its expansion may grind to a halt in the near future unless something is done to assure adequate new supplies.

A superficial look at our present gas reserves suggests that there is little cause for worry. The nation's proved gas reserves are still higher than oil reserves, on an energy basis, and still high enough to supply pipelines at their present rate for many years.

But, as a significant article in this issue effectively demonstrates, future expansion of the gas business depends on future discoveries. And recent trends in geology and economics cast serious doubts on the ability of the industry to keep reserves expanding.

CHEAP NATURAL GAS is about gone; that is, it has practically all been dedicated to existing markets. This has been said many times, but its significance has not been well understood.

Gas-utility spokesmen blithely predict unlimited expansion—basing this entirely on past conditions and ignoring the present. But the record of the past few years contains a grave warning.

The trend of gas discoveries is downward, but the trend of gas consumption is upward. Should these trend lines cross—and they could in a very few years—expansion will be stopped cold.

Less obvious is the fact that reserves must always assure a 20-year supply. Pipelines and distribution systems are financed on 20-year bonds, and such bonds can't be sold—or won't pay out—if supply fails before the facilities are amortized.

Gas reserves are added only by drilling many wells probing for either oil or gas. Our present drilling rate is too low to reverse the downward trend in gas discoveries.

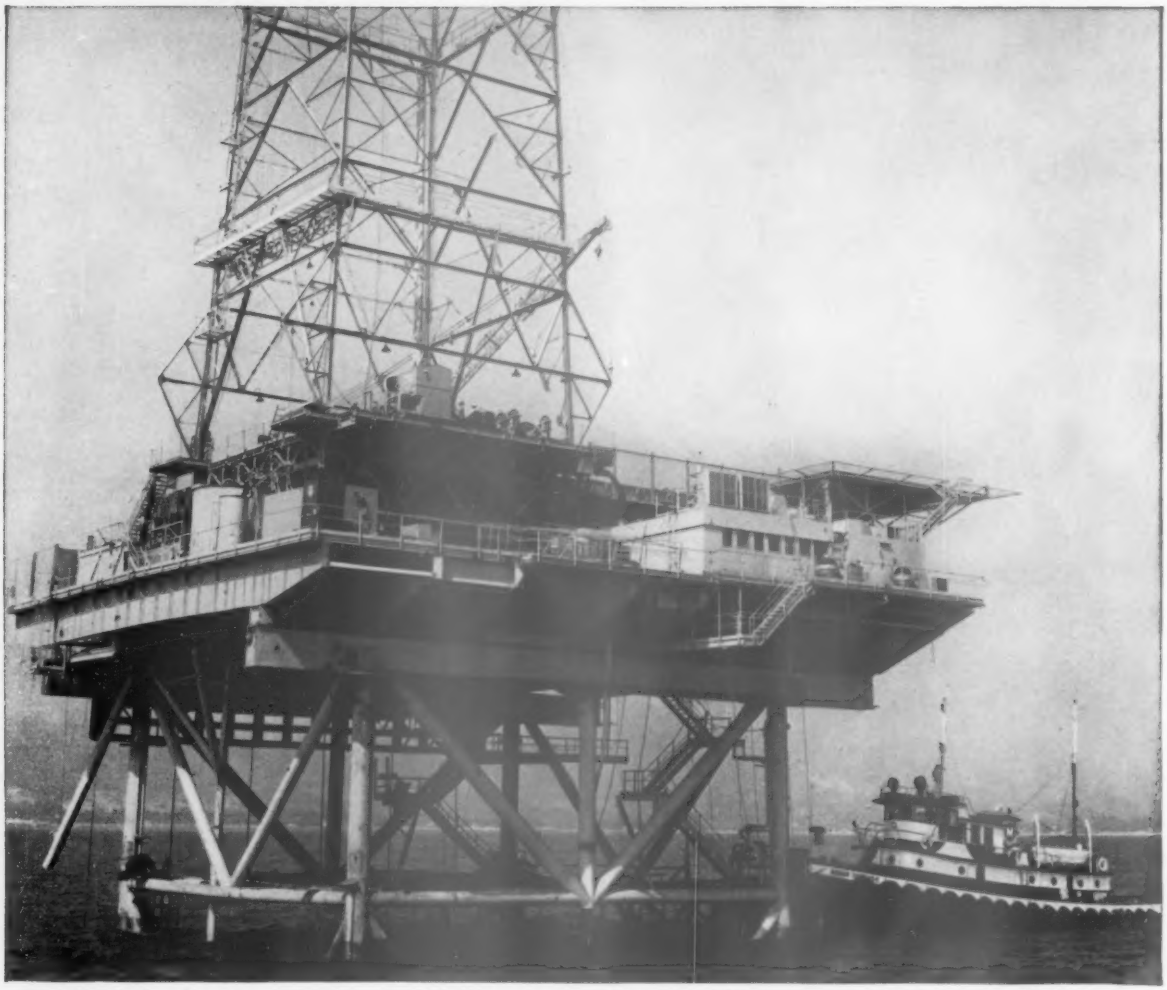
The drilling rate depends primarily on the industry's total income from sale of oil and gas at the wellhead. For many years crude-oil sales largely financed additions to gas reserves.

But today significant reserves are found only at great depths, and are costly to drill. More important, deeper reserves have an increasingly larger proportion of gas to crude.

This means that oil cannot carry the major part of the cost of developing gas reserves. The wellhead price of gas itself must provide the incentive to increase gas reserves.

BANKERS AND INVESTORS, as well as gas pipelines and distributors, should be deeply concerned about this condition.

Federal regulation holding gas prices arbitrarily low may benefit present customers as long as their reserves last. But it will most certainly throttle the prospects for continued growth of the gas business.



Monel alloy sheathing protects against tidal zone corrosion of structure supporting first permanent drilling platform off California shore. Platform is jointly owned by Standard Oil Company of California and Humble Oil and Refining Company. It was fabricated by National Steel and Shipbuilding Corp., San Diego, California.

Supporting California's first permanent offshore platform...

sea legs defended from corrosion with Monel*

Key concept in this offshore drilling platform is *permanency.*

It's designed not only for drilling but also for year-after-year *production* of up to 25 wells.

Jointly owned by Standard Oil Company of California and Humble Oil and Refining Company, the platform is located two miles off Summerland in 100 feet of sea water. An unusual 140-foot derrick rigged for dual operation permits drilling two wells at a time.

Structure is built to last

In designing the platform, considerable attention was paid to the problem of preventing sea water corrosion of the supporting structure. For about 10 feet...in the critical splash and tidal zone where painting is impractical and cathodic protection is non-continuous . . . all vertical and cross members are sheathed with Monel nickel-copper alloy.

Experience on the Gulf Coast and with radar islands has shown that in this critical zone Monel alloy sheathing offers the best and least expensive corrosion protection.

When made of Monel alloy many items of equipment last longer

Monel nickel-copper alloy is ideal for equipment exposed to the corrosive conditions common in oil fields . . . salt water, acids, sour crudes. In instrument parts, screen cloths, polished rods, valves, pump parts, many other items, Monel alloy is widely used.

An Inco booklet "Metals to Make Petroleum Equipment Produce More", goes into details. We'll be glad to send you a copy.

*Inco trademark

HUNTINGTON ALLOY PRODUCTS DIVISION
The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

MONEL®

Tidelands Fight Is Far From Over

● Many questions concerning the ground rules for operating in the Gulf of Mexico will remain even after the Supreme Court hands down its long-awaited decision on who controls Zones 2 and 3.

By Howard Wilson
Gulf Coast District Editor

AFTER the decision, what then? There will be plenty.

The "decision," in Louisiana at least, concerns the tidelands boundary and the untold millions of dollars, perhaps a billion, in mineral money at stake.

Win or lose, the Gulf Coast states and the U. S. Government will continue to wage war after the Supreme Court renders its verdict on whether the states' seaward boundary extends 3 miles or 3 leagues into the Gulf of Mexico.

The legal issues which are bound to arise over the decision will be tangled ones, and further litigation can be expected to drag through the courts for years.

Here are some of these issues:

... **How do you determine** where the coastline is located in order to draw a line 3 miles or 3 leagues seaward? This is a major question, and jurisdiction over rich oil fields may be riding on the final answer.

... **If the court** sets the state boundary at 3 miles, and the U. S. later approves an international treaty setting the U. S. boundary at more than 3 miles, what happens then?

... **What will happen** to some $340 million now held in escrow while the issues arising out of the court's decision are being settled?

... **To what extent** will the federal Government exercise control over allowables, drilling, production, and other operations after its offshore territory is established?

... **If differences arise** between Louisiana and the federal Government over the size of offshore allowables, what will be the repercussions?

... **What will be the legal status** of oil and gas produced beyond the seaward boundary of a state? Will it be "foreign" oil subject to import restrictions? How will the Connally Hot Oil Act affect it?

Status today . . . In Louisiana, where the stakes are biggest, the federal and state governments have operated under a joint agreement since late 1956 while the boundary lawsuit has crept slowly through the Supreme Court.

The court last fall heard the final oral arguments, received the final briefs, and took the case under advisement. The only thing remaining in the basic case is the decision itself.

Meanwhile, Louisiana and the U. S. Bureau of Land Management have leased acreage jointly in offshore Zones 2 and 3, both located in disputed territory.

Some $340 million currently is held in escrow by the U. S. treasury for the winner of these tracts in the legal war. The money represents lease bonuses and royalty payments.

Although the treasury in Washington holds the money, the conservation department in Baton Rouge has fixed the rules for drilling and producing oil and gas. Operators in the disputed waters, as well as the operators in clearly federal waters further seaward, look on the State of Louisiana as the authority for production allowables, spacing, and drilling practices.

Leasing of tracts in Zones 2 and 3 must be approved by both Louisiana's State Mineral Board and the Interior Department's Bureau of Land Management.

The survey . . . Anticipating the problems arising from the imminent Supreme Court ruling on the offshore boundary, the federal Government and the State of Louisiana long ago named a joint six-member committee to do preliminary spadework.

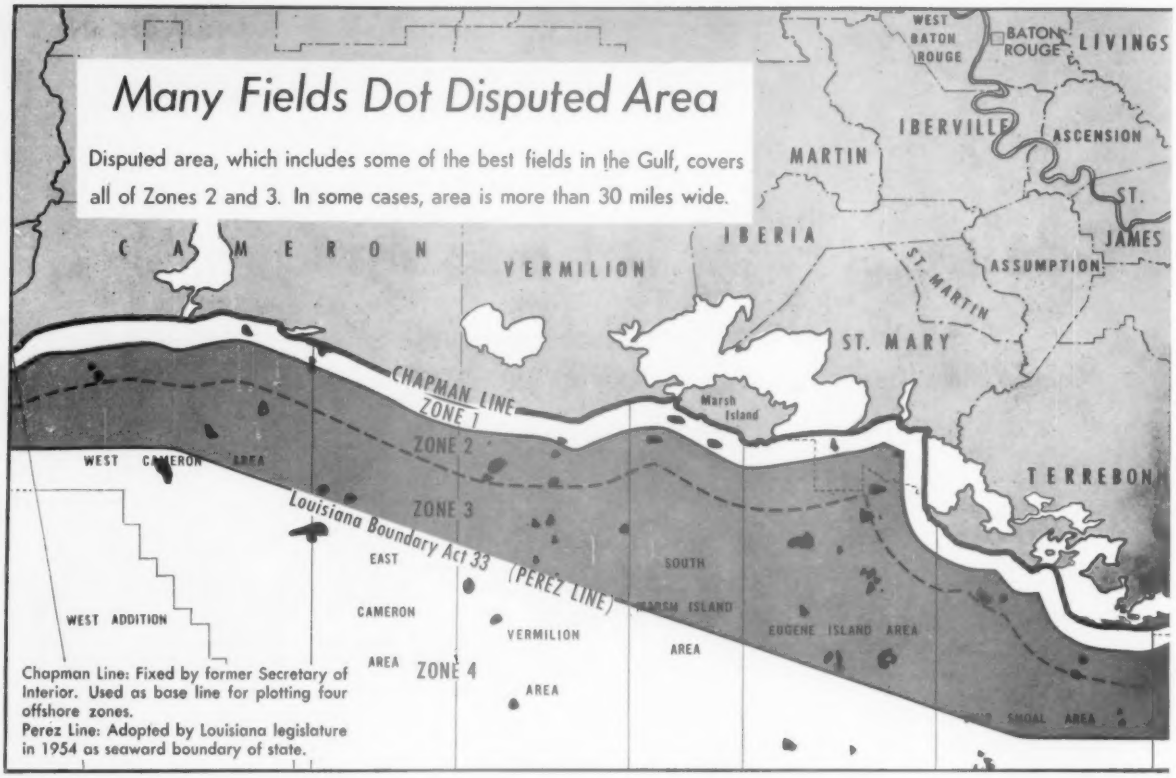
The committee, working primarily from aerial surveys, has the job of determining where the ephemeral Louisiana coastline really lies. Its

How Much Oil Is Involved?

IT DOESN'T TAKE long to figure why Louisiana is fighting so hard to retain control of the tidelands beyond the 3-mile point. During 1959, 46.70% of the crude and condensate produced off Louisiana came from Zones 2 and 3, the two zones claimed by both Louisiana and the U. S. Even a bigger percentage of Louisiana's offshore gas production, 68.20%, came from the disputed zones.

Here's a break-down on Louisiana's offshore production in 1959:

Area	Crude (bbl.)	Condensate (bbl.)	Casinghead (M.c.f.)	Nat. gas (M.c.f.)
Zone 1	30,357,637	446,427	30,794,247	37,836,725
Zone 2	18,481,271	1,263,051	16,720,948	82,646,331
Zone 3	10,154,709	486,311	11,852,520	90,861,207
Zone 4	3,655,240	220,158	2,811,337	22,778,920
TOTAL	**62,648,857**	**2,415,947**	**62,179,052**	**234,123,183**
Total 2 and 3	28,635,980	1,749,362	28,573,468	173,507,538



powers are strictly advisory, and its duties are scientific, not political.

As every operator in the area knows, there are reefs and islands of the now-you-see-it-now-you-don't variety. They are here today and gone tomorrow. Or they may be gradually building up or eroding away.

If an acceptable offshore boundary is to be drawn, whether 3 miles or 3 leagues, or something else, it is necessary to know from what points on the coastline the surveyors will measure.

The committee has pretty well determined about 70% of the coastline because the point at which the land meets the water is fairly stable and definable.

But the difficult part of the job lies in the vast Mississippi Delta and that Atchafalaya Bay area, where ragged bays and inlets abound, where reefs disappear overnight, and small solitary bits of land barely reach the surface and disappear with the incoming tide.

The committee has made lengthy observances of spots in question and will report its findings later.

Two of the chief committee members are Gordon Atwater, New Orleans geologist, representing Louisiana, and Earl Harrington, chief cadastral engineer for the Bureau of Land Management.

The rules . . . The basic issues involving the Louisiana coastline are yet to be settled, and the federal-state survey committee won't be the arbiter.

These issues involve such technical points as to what constitutes a bay, what is inland water, and how close must islands or points of land be together to constitute a continuous coastline

These and similar questions may produce new litigation before the boundary dispute is resolved.

Some attorneys in the tidelands case hope the Supreme Court, in making its ruling, will go a step further and appoint a master to receive testimony on these points and make recommendations to the court for an exact delineation of the boundary. But even this will require weeks and months of courtroom appearances, survey work, and briefing on points of law on boundaries. It is here, of course, that the work of the joint federal-state surveyors will come in handy.

The present lines . . . Offshore Louisiana currently is divided into four zones, whose lines were fixed by joint, but strictly temporary, agreement by Louisiana and the Interior Department in 1956.

The point of reference (the Louisiana coastline) for the first two zones is the so-called Chapman line, drawn by a former Secretary of the Interior and loudly disputed by Louisiana. It was drawn, says Louisiana, without benefit of survey or mutual agreement as to what constitutes a point at which the land quits and water begins.

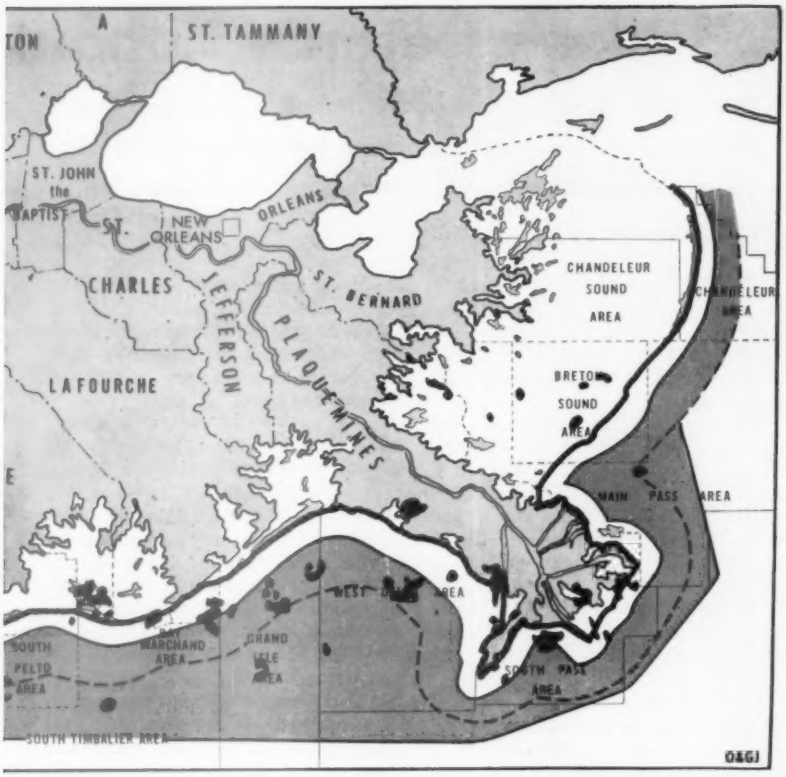
Both the state and federal governments agree that Zone 1, which consists of territory in the first 3 miles seaward of the Chapman line, is definitely Louisiana's. Bonus payments and royalties on leases in this area now go into the Louisiana treasury.

Zone 2 extends beyond Zone 1 to a point 3 marine leagues (about 10.5 miles) from the Chapman line. This, of course, is disputed land, and revenue from it goes into escrow.

Zone 3 is a widely varying strip of water seaward from Zone 2. Its outward boundary is defined by an act of the Louisiana legislature in 1954 and is known as the Perez line. It represents a line established originally by the U. S. Coast Guard to mark the point at which rules of the open sea change to those of waters approaching the shore. The Louisiana Act defines this line to be the state boundary, and therefore the tracts located in Zone 3 are disputed. Money from them also goes into escrow.

Waters in Zone 4 are those seaward of Zone 3's Perez line and are strictly in federal territory.

The treaty issue . . . Louisiana officials are watching closely the little-publicized but, to them, potentially impor-



tant work of an international body—the United Nations Conference on the Law of the Sea.

The conference is scheduled to meet soon and Louisiana officials are vitally interested in what this body does since they believe it may effect the nation's seaward boundary.

When the conference met in Geneva in 1958, the U. S. argued for a 3-mile limit on international boundaries. Russia and other nations argued for 12 miles. One nation even supported 200 miles. No agreement was reached, but there was more sentiment for 12 miles than for 3. Louisiana sees the possibility of a compromise which would given them a break.

The same Geneva Conference also drafted a set of rules to define a nation's coastline. The senate foreign-relations committee now has these recommended rules before it. If approved by the Senate as an international treaty, they will form the basis for setting the U. S. coastline—and Louisiana says this may have a bearing on the tidelands case.

One thing is certain about the treaty issue. If the Supreme Court sets the seaward boundary of Louisiana at a distance less than a distance later approved by the U. S. Senate under international treaty, the state will go to court again.

Federal officials maintain, however, that any international agreement on boundaries would have little or no effect on the federal-state issue.

The international boundary under discussion concerns surface rights—the commerce of the seas. Underwater mineral and other rights are not involved.

They point out that when Harry Truman was president he proclaimed U. S. jurisdiction over mineral matters in the Outer Continental Shelf area. And that shelf extends far beyond the 3-mile boundary the nation has historically observed as far as surface rights are concerned.

Furthermore, federal officials say that the Submerged Lands Act passed by congress specifically sets the state limit at 3 miles—with the possible exception of the Gulf Coast states which were given a right to attempt to prove that their historical boundaries at the time they were taken into the Union extended 3 leagues, rather than only 3 miles.

In other words, the state boundary is set by congress, and has no relation to an international boundary the U. S. agrees to or asserts for itself. Thus, if the Supreme Court rules that Louisiana has not proved its rights to a boundary beyond 3 miles, the state would then be faced with that limit, regardless of whether the U. S. agreed to an international boundary of 9 or 12 miles—or more.

As for oil beyond an international boundary being "foreign" oil, they point out that it would be oil produced within this nation's jurisdiction, thereby making it domestic oil. They note that this practice is already in effect for oil now produced off the Louisiana coast more than 3 miles from shore.

The money . . . It is conceded by both sides that the $340 million tied up in escrow won't be turned loose the day after the Supreme Court reaches its verdict in the current case.

Subject, of course, to wording of the decision, it is likely that some of the money, can be distributed fairly soon by mutual agreement.

Louisiana, in particular, will be anxious to collect its cash as quickly as possible. The state faces a real financial crisis, and the legislature this year has the onerous job of deciding whether to reenact a 2-cent gas severance tax which expires in August.

Federal rules . . . Once the federal Government's offshore domain is firmly established, the Bureau of Land Management will be faced squarely with the mansized job of regulating its property (OGJ, Feb. 22, p. 64).

The BLM hopes it can continue the current policy of relying on the state to set the production allowables and draw the field rules. But conflicts may very well arise because the federal Government's prime interest lies with the offshore operator who wants high allowables for his heavy investment.

The BLM has no thought at this time of taking over regulation of onshore properties in the U. S. There is a legal question as to whether the U. S. could rightfully assume jurisdiction over onshore properties surrounded wholly by state lands. This issue has never been tested, and no one has seen fit to bring the matter into court because of the satisfactory results of the present system.

The offshore leases are a different matter. They are not in any state—and, for that matter, may not even be in the United States. This, itself, is a legal question that may find its way into court.

Some persons have even suggested that unless Congress passes new legislation, oil and gas produced on federal offshore leases must be considered "foreign" oil and, as such, prohibited from entry into the U. S. except under the import control program.

This is a far-fetched assumption, but there certainly will be some searching of the lawbooks and court decisions to determine the exact rights of operators producing on federal leases. The Connally Hot Oil Act has provi-

sions concerning movement of oil in interstate commerce that may require revision lest a strict interpretation make such movement impossible.

In fact, it is possible Congress will be called on to pass a special oil conservation act much like many states already have done.

This, of course, is what many oil producers dread—another inroad of federal regulation.

But one large operator in offshore Louisiana last week said he would favor federal regulation and fixing of allowables. His position was one of self-interest. The large offshore producers, he argued, are outnumbered heavily by the army of small onshore producers, and the political pressure of the many has resulted in unfairly low allowables for high-cost offshore wells.

Negotiations . . . To forestall a battle over allowables between the state and federal governments, officials of the two already have held their first exploratory meeting in search of an agreeable middleground.

The meeting at Baton Rouge on March 3 was short but friendly, and the representatives assured each other they wanted to work cooperatively.

The federal Government's hope is that the Louisiana Conservation Department will continue to set the offshore allowables and regulate drilling and production.

The negotiations have been complicated, however, by the fact that Louisiana's top oil agency officials may be changed when a new state administration takes office in May.

Jimmie H. Davis, the democratic nominee for governor who is expected to win the election handily, has made no known comittments on the appointments. Ashton Mouton is the conservation commissioner, and William G. Helis, Jr., is chairman of the State Mineral Board. At least one and possibly both will be replaced.

If the Supreme Court rules against Louisiana, there is little doubt the state could exert a tight squeeze on offshore producers by changing the allowable formula. In fact, at least one high official already has suggested that allowables for multiple-completed wells be scrutinized carefully if the state has to cut back its production.

The industry generally hopes sincerely that Louisiana and the U. S. Government can meet each other halfway and continue their cooperative arrangement.

But this and many other problems still loom darkly ahead as oil men look to the Supreme Court and ask: "After the decision, what then?"

Strikers Return Without

• Indiana Standard stands by demands at Sugar Creek and workers finally return, ending longest strike in recent years. Negotiations will continue on work rules which touched off 241-day strike.

ONE FACT emerges from the end of the 241-day strike at Indiana Standard's Sugar Creek refinery: A skeleton crew can operate a modern refinery for an almost indefinite period of time.

The knowledge that they were not able to shut down the 75,000-bbl. refinery near Kansas City played a major role in the decision of local members of Oil, Chemical, and Atomic Workers International Union to return to their jobs early last week.

Another factor: A back-to-work movement was developing which imperiled union discipline over the members.

Many of the workers had exhausted their financial resources and desired to return to work. This is reflected in the sudden jump in the number of workers who crossed picket lines to take up their old jobs just before the union decided to end the walkout.

The issue which precipitated the strike also had lost some of its glamor for the long-idled workers. The basic issue in the contract dispute had been over work rules which management claimed challenged its right to operate the refinery effectively. Wages were never an issue.

Back to work . . . The strike—the longest in the oil industry in recent years—ended suddenly at 11 p. m. March 4 when the union withdrew pickets from the refinery gates.

This action followed closely a vote by union members to return to work unconditionally. No working agreement was signed.

After this membership vote late on March 4, OCAW Agent W. F. Noell telegraphed Plant Manager P. C. Livesay that the union was withdrawing pickets and was instructing employes to return to work unconditionally and added "we shall continue to negotiate for a collective bargaining agreement."

Employes first were asked to report at the refinery office to register their desire to return to work. Livesay

OCAW MEMBERS sign up to return to work at Indiana Standard's Sugar Creek, Mo., refinery. The workers went out on strike July 8, making the strike the oil industry's longest in recent years.

a Contract

said those registered will be called back as they are needed.

A small group reported Sunday evening, March 6, and another for the Monday morning shift. By mid-week nearly 150 had returned.

The OCAW originally called 760 operating and maintenance workers out on strike last July 8. They shut down the refinery for only 2 days. Then, supervisors and professional employes partially resumed operations.

Some strikers began to return to work in the plant as early as last August. This number increased to a peak of more than 200 before the pickets were removed. Crude throughput ultimately reached 83% of capacity.

Work policy . . . All the striking workers may not have jobs.

Indication of this was contained in the statement of Livesay that in the swing from strike-time to normal operations workers could be called as and if they are needed.

Livesay announced in reinstating the first two groups of returnees that plans were to integrate the men into operations as rapidly as feasible.

Officials at the plant explained they didn't know exactly how large a force would be needed now at the plant. Changed plant operations and a recent crude cutback because of industry conditions have altered the plant's manning needs.

The company is also offering early retirement to those who are 60 or will be 60 years old by April 1. Livesay issued a statement last week offering the early-retirement proposal. He said severance pay ranging up to $5,600 will be paid retiring workers.

The company's final strike settlement proposal had included provisions for orderly return to work of striking employes and a severance allowance to help some who may not be returned. The union rejected this only a week before the membership decided to end the strike unconditionally.

On the matter of further negotiations, Manager Livesay said: "We have met with the union representatives 46 times in previous negotiating sessions over an 11-month period. We, of course, are agreeable to a continuation of bargaining."

Federal Conciliator Arnold Griffith said in Kansas City he soon would contact both union and management representatives to resume bargaining sessions in an effort to reach a contract agreement.

watching WASHINGTON

Clyde La Motte

• Choice for FPC: Shoot or give up the gun . . .

THERE ARE THOSE who figure that the Federal Power Commission is reaching an either-or-else stage.

Either it works out a method for better and prompter handling of natural-gas rate cases or else someone will undertake to do the job for it. This could lead to a drastic overhaul of the entire governmental regulatory approach.

Such a change might not be undesirable. There would be, however, the uncertainty over what the new method might be or in what direction it might lead. Conceivably, a substitute system might be as bad as, or worse than, the present system.

At any rate, the evolution of a new method would take time, and time is beginning to run out for the beleaguered producers, pipeliners, and distributors who are bogged down in the quagmire of present controls.

Time is also running out for the FPC. There is a growing awareness at that agency that it must regulate or get off the pot.

Because of these factors, a great many eyes will be watching the attempts now being made by the FPC to trim some time from the years-long process now required to settle many rate cases (OGJ, March 7, p. 57).

• Half a loaf is better than none, or is it? . . .

THERE ARE TWO key points to the FPC effort to find some practical shortcuts in the long, winding regulatory paths now followed. One is the interim decision. The other is the pre-hearing conference and related moves designed to clear out the underbrush.

The interim-decision approach simply is settling parts of a case at a time instead of waiting until every issue is settled before a decision is made.

For instance, suppose that in a $25-million rate case, one issue can be settled ahead of the others because it requires less field study by the FPC staff and less time for all parties to submit their arguments. And suppose that this one issue alone affects $15 million of the total.

Proponents of the interim approach say that it would be better to have an interim decision on the part affecting $15 million than to wait a year or two or more to get all issues settled. At least, they say, the sellers and the buyers involved would have only $10 million left tied up in payments subject to refund, instead of the entire $25 million.

Furthermore, they figure that as the original total is whittled down by interim decisions, it will be simpler and easier for the parties to reach an agreement on the remaining issues, thereby eliminating the need for lengthy hearings on them.

Many companies are wary of this piecemeal procedure, however. They fear it would encourage the FPC to handle cases by dibs and dabs rather than facing up to the over-all problem. And frequently, they say, it is impossible to sever one issue out of a case to be settled without relation to the other parts of that case.

Some current cases in which the interim decision will be tried may help determine the feasibility of this maneuver.

• Some cooperation all around might help . . .

THERE APPEARS to be more enthusiasm over the possibilities of the pre-hearing conference than over the interim-decision technique.

Ideally, in the pre-hearing conference, all sides would agree to as many facts and figures as possible, and they would agree on procedures designed to eliminate pointless or unnecessary testimony and cross examination. As a result, the hearing could concentrate on key issues.

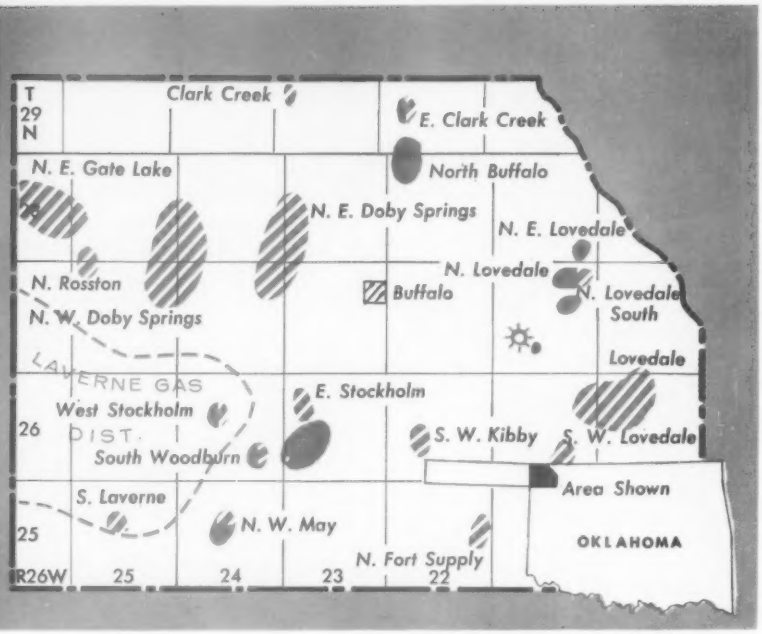
Of course there is always the possibility that one party or an intervenor will deliberately try to slow things down—either because of extreme caution or through sheer cussedness. Perhaps in such a situation a capable hearing examiner may be able to prod them into action.

Harper County . . . Oklahoma Hot Spot

RUNDOWN:

1960–
- 1 Prospective discovery
- 12 Field-well completions
- 25 Active rigs

1959–
- 6 Discoveries
- 7 New pays, extensions
- 95 Field-well completions



Rigs Busy in Northwest Oklahoma Play

• The hub of activity is in Harper County where operators' score so far this year reads one prospective find and 12 field wells. The county—which had no production 7 years ago—now has 21 oil and gas fields.

ONE of the busiest and most interesting oil and gas hunting grounds in the Mid-Continent is Harper County, northwestern Oklahoma.

There are 25 rigs working in the county; and in the first 2 months of 1960, some 12 field wells have been completed. Last year the county boasted six wildcat discoveries, seven wells that found new pay zones or extended pools, and 95 field wells.

Just how far the area has come in 7 short years is shown by these additional statistics: From no production in 1953, the county has jumped to 400 gas wells and 176 oil wells producing from 21 fields. Twelve different pay zones have been discovered, ranging from the Cambro-Ordovician to Pennsylvanian in age.

Eighteen companies have been attracted by the new play. Included are Atlantic Refining, Cabot Carbon, Sunray, Pan American, Blackwell Oil & Gas, Shell, Vickers, Texoma, Pure, Statex, Santiago, Gulf, Union, Apache, Phoenix Enterprises, Phillips, and Sinclair.

Bulk of the major discoveries in the last 2 years have been credited to Sinclair, particularly at North Buffalo and East Ciark Creek fields.

Harper County development currently is following four trends:

. . . **Laverne** gas district development.

. . . **North Buffalo** multipay field expansion.

. . . **Evaluation drilling** around last year's discoveries.

. . . **Testing** for the third Hunton Siluro-Devonian producing area in the Anadarko basin.

Busy Laverne . . . Majority of the county's working rigs are concentrated in the Laverne area.

Oil and gas production in Harper County was first discovered at Laverne in 1953. Since then the field has fanned out in all directions. The current play is to link western Laverne with Highland field in Beaver county.

This vast gas and oil field is one of the largest producing regions in northwestern Oklahoma with 340 gas wells completed and 100 oil wells producing. Four pay zones are producing so far in Laverne. They are the Hoover, Tonkawa, and Morrow sands of Pennsylvania age and the Chester Mississippian sand.

The Laverne development also has featured dual and triple completions. This attractive phenomenon is carrying over into the North Buffalo field.

Most recent example of duals is Sun's 1 Fouts in 10-25n-26w, which was completed in both the Hoover and Morrow sands. Sinclair completed a triple-pay producer at 1 Gibson Unit in 21-26n-24w. That well found gas-condensate production in the Hoover, Morrow, and Chester.

The well bringing the Laverne-Highland linkup closer is Sohio's 1 Mulberry in 34-27n-26w. It was completed as a Chester producer with a rated open flow of 13,300 M.c.f. daily.

The string of attractive wells thus gives Laverne such impetus it stands to lead development work in the county for several years.

The payoff . . . The North Buffalo field has become one of the Anadarko basin's all-time great discoveries.

Uncovered by Sinclair in 1958, the field since has produced from seven different pay zones—the Viola Ordovician, Arbuckle Cambro-Ordovician, Lansing, Morrow, Kansas City, and Oswego Pennsylvanian, and Chester Mississippian. This is the greatest number of producing zones for any single field in the basin.

North Buffalo's 20 producers and dozen active locations make it a key area to watch for developments during 1960. The seventh pay—the Viola—is only a fairly recent development in North Buffalo. The possibility of other pay zones plus good odds for multipay completions keep the field in the spotlight.

The Viola producer was Sinclair's 1 Shupe which flowed 100 bbl. in 10 hours on ¼-in. choke from 7,252-56 ft. The same well also had Lansing and Arbuckle production.

The Shupe well was the third triple completion and the twelfth producer for the North Buffalo field. Seven have been dual completions and the rest singles all from the Arbuckle. A second Viola well is the 2 Holcomb which flowed 9,972 M.c.f. daily of gas and 13 bbl. hourly of condensate.

New areas . . . Evaluation and extension plays stemming from last year's discoveries are being staged over the county.

East Clark Creek field is one of the new areas holding much promise. Sinclair made a dual completion of its 1 Buzzard, the field's second producer. The Elgin (Hoover) sand was good for 24 bbl. daily at 4,366-73 ft. The well also had Morrow gas-condensate production.

Sinclair last year opened East Clark Creek field just south of the Kansas line with the 1 Rohrer in C SE SW 20-29n-22w. The well made 7,592 M.c.f. daily of gas and 18 bbl. of condensate in 12 hours from Morrow at 5,701-11 ft. Sinclair engineers hope the field will become another important multipay producing area north of Buffalo.

Activity in older areas also is turning up some surprises. Oil production was opened in Northwest May field by Pan American at 5 Catesby Operating Unit in 28-25n-24w. Flow was 16 bbl. per hour of heavy oil on tests. This field has two other producers — both Morrow gassers.

Another extension of Northeast Doby Springs field is reported at Union Oil 1 Heironymous. It flowed 4,700 M.c.f. daily of gas from the Morrow.

New Hunton finds . . . The third Hunton field in the Anadarko basin may emerge from two wildcats of Statex Petroleum in the Lovedale area of Harper County.

Some operators, however, believe the wells may be getting their production from the Viola.

The 1 Weaver in 28-27n-21w, offsetting a possible Hunton gas well northwest of Lovedale, also recovered 3,300 ft. of oil on tests at 7,290-7,316 ft. The 1 Bennett in 29-27n-21w is testing Hunton gas at 7,233-45 ft.

If these wells are officially tagged as Hunton discoveries, nearest similar production will be 44 miles east on the basin shelf at West Greenburg field in Woods County. That field has small Hunton production.

First Hunton production inside the basin was found last year at West Campbell in Major County by Sinclair's 1 Spafford. Then Mobil found the first production in Custer County at a deep Hunton discovery in the trough area of the basin.

The Mobil discovery was hailed as one of the most important in Oklahoma for many years. It yielded a prolific flow of gas condensate, firing new interest in both the deep potential of Anadarko basin and the Hunton as a prime producing horizon.

Senate Action on Fuels Policy Is Possible

- A similar move by the House to create a special study committee to determine a national policy is less likely.

THE COAL industry is still making headway in its efforts to get a congressional committee established to draft a national fuels policy.

The Senate rules committee may clear the way this week for Senate floor action on a proposed resolution which would authorize the study.

The resolution is being toned down considerably from its original form, but it is still objectionable to many oil industry people.

Washington observers think a modified resolution may be passed by the Senate, but they consider it less likely that the House will take similar action this year. (At this point, a House resolution is before the House rules committee but there has been no indication that it will be voted out of that committee for House floor action.)

The stage for possible Senate action was set last week at a meeting of oil and coal industry representatives called by Sen. James E. Murray (D.-Mont.) chairman of the Senate interior committee.

The purpose of the meeting was to study a modified version of the resolution which Murray had drafted in an effort to lessen objections which had been raised by the oil industry since the original resolution was introduced last fall.

Oil's objection . . . During the meeting, further modifications were suggested in an effort to meet the basic oil-industry objection: That the resolution was pointed in the direction of end-use controls of fuels.

At the conclusion of the meeting, the committee staff said it would give interested parties another week in which to submit further views. Then, the committee indicated, it will be ready to make its proposals to the rules committee.

This was the tone of last week's meeting:

Spokesmen for oil organizations said there was no need for a special committee at all because there are existing congressional committees with authority to make any such study they feel is needed.

Furthermore, the oil spokesmen said, if there is to be a committee assigned to do such a study, the assignment should not spell out what course the committee should take.

Specifically, oil spokesmen objected to such language as this direction in the original resolution: "The joint committee shall . . . give consideration to . . . the optimal allocation of the various fuel energy resources to their most productive economic uses, including such consideration as the geographic distribution of these resources and the development of balanced and interrelated regional fuel economies . . ."

Oil representatives said this meant, in effect, a roping off of certain areas of the nation for certain fuel uses, rather than leaving to the consumer a choice of fuels.

Before last week's meeting was over, it appeared likely that some of the objectionable phrases would be deleted, particularly the one calling for "optimal allocation" of energy.

Representatives of the coal industry and coal unions at the meeting insisted they are not seeking end-use controls. They said that all they are calling for is the establishment of a congressional committee to investigate the fuels picture and determine what steps, if any, are needed to assure the nation an adequate supply of energy.

Oil representatives made it clear that they are not endorsing even the modified resolution.

How Virginia Marketers Fight Gasoline Taxes

• Curb signs at service stations show the price of gas less the tax. This has spurred the customers' interest and it is hoped they will protest a proposed tax hike.

VIRGINIA motorists are being made acutely aware these days that they are paying 10 cents tax on every gallon of gasoline they buy—and that they face the danger of paying even more.

Here is how they get the message: Many service stations throughout the state are posting curb signs which give the price of the gasoline, excluding tax. Thus, a passing motorist sees a price of 19 cents (or thereabouts), instead of 29 cents.

The curb sign clearly states, in 3-in. letters, that the price shown excludes the tax. The motorist who fails to notice this, or doesn't realize what it means, is told about it at the service station. And the price, including tax, is still shown on the pump.

This "education" of the motorist is being undertaken in a campaign sponsored by Virginia Petroleum Industries. It stems from a feeling on the part of marketers that most people are only vaguely aware of just how high the taxes on gasoline have risen.

New tax . . . The Virginia action was spurred at this time, too, by the fact that the Virginia legislature is now actively considering a 1-cent hike in its present 6 cents a gallon tax. Therefore, one obvious reason for the program is to awaken the public to what this would mean.

Leaders of the campaign say they are getting fine cooperation from oil companies and from service-station operators. They estimate that 75% of Virginia's service stations have posted curb signs with the "ex tax" price.

And they say the campaign has created a great deal of comment from customers. The prize example cited is the woman motorist who asked for $3 worth of gasoline. The attendant, after putting the gasoline in the tank, explained to her that she was paying $2 for the gasoline and $1 for tax. She immediately protested that she had never had to pay a gasoline tax before and wasn't going to start doing so now.

After the attendant convinced her the tax was not new, she drove away muttering about such an outrageous tax. Oil marketers are hopeful, of course, that she will relay her sentiments to her legislator.

There were some kickbacks, too, in the early days of the campaign. Some motorists, swinging into a station after spotting the low prices, felt they had been tricked. In most cases, however, the motorist was mollified after the situation was explained to him.

There was also a fear on the part of some, at the outset, that the low prices would trigger price wars before all service stations found out what was being done. This did not happen, apparently because an effort was made to let all stations know of the pending campaign.

A success . . . Claiborne D. Gregory, executive director of Virginia Petroleum Industries, thinks the campaign—under way now for 10 days—already has been a success. No date has been set for switching back to the conventional posting of a curb sign which includes the tax and Gregory is hopeful that the new method will be continued indefinitely.

Here is how the campaign was shaped up in Virginia:

After the marketers had agreed to undertake the program, the plan was explained to the service-station operators and their cooperation was solicited. As Gregory points out, participation was on a voluntary basis.

A starting date for the campaign was set and the service stations were given "ex tax" decals to put on their price signs. They were also given a supply of handouts to distribute to the motorists. This was the language on the handouts:

"The price advertised on the curb sign is the price of the gasoline alone. The price you are paying is the price of the gasoline plus 10 cents in state and federal taxes.

"Moves are now under way in the state legislature to further increase this tax. If you don't want to pay any more for gasoline taxes, communicate now with your representatives in the state legislature. They can add miles to your driving dollar by keeping taxes down.

"Gasoline is a buy, only the tax is high."

Suggestions for others . . . Gregory says he has already received queries from a half-dozen other states showing an interest in launching a similar campaign. He makes these suggestions for anyone interested:

. . . Get the principal companies interested, particularly the market leader in your area. Don't undertake it unless there is near-unanimous agreement.

. . . Be sure to emphasize an exact starting time for the campaign, because misunderstandings can crop up if one service station makes the move before others do.

. . . Expect some kickbacks the first few days, but encourage faint-hearted marketers or operators to stick with the campaign for a few days. (Gregory says that by the third or fourth day, complaints stop.)

. . . Make sure all stations have the necessary decals and explanatory materials.

INDUSTRY BRIEFS . . .

The merger of Union Oil & Gas Corp. of Louisiana and Texas Natural Gasoline Corp., has been approved by stockholders. The continuing corporation is Union Texas Natural Gas Corp. Gas-liquids business of the company will be operated from offices in Tulsa, while principal offices will be in Houston (OGJ, Feb. 8, p. 59).

North Star Oil Co. has acquired for stock and cash a one-half interest in eight producing wells in Shannon field, Crockett County, Texas. The wells were purchased from Dugger & Holmes, San Antonio independents. Last December, the company bought an interest in eight wells in Ector and Andrews counties, and the company now is negotiating for three gas wells in San Patricio County, Texas.

The first underground storage of LPG in Utah is being developed 2 miles north of Moab by Suburban Gas Service, Inc. The cavern to be formed in the salt formation will have a capacity of 100,000 bbl.

Value of oil and gas produced in North Dakota last year reached $48,434,299, the state tax department has announced. This is more than $7 million greater than for 1958. State taxes

California's Jones Pool: After the Boom

RUSTY pumping jacks dotting an area in Huntington Beach, Calif., stand as mute testimony to the folly of over-development.

The clusters of pumps—half of them idle—also signify completion of a cycle at Huntington Beach's Jones pool—from a quiet residential area, to a hectic town-lot boom field, and then bust and now home building again.

When the drilling boom hit the small coastal town in the spring of 1955, homes were moved off town lots to make room for drilling rigs and later pumps. Now the pumps are gradually being displaced by homes again.

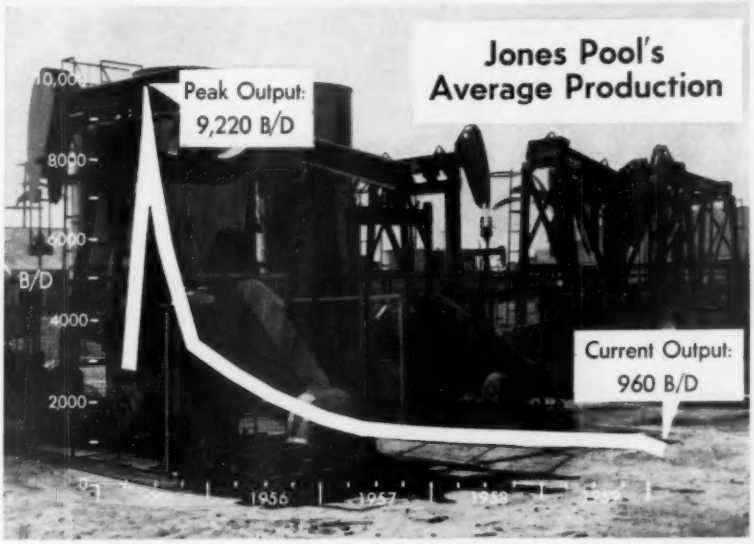
The Jones pool play offers a classic example of the pitfalls of town-lot drilling in California.

Although the pool has produced a respectable 4.5 million barrels in its short lifetime, oil men generally agree the only person who'll make any money will be the red ink salesman.

Conditions were tailor-made for what occurred. The Jones pool was in an area comprised largely of small 25 to 100-ft. town lots. It was also an area of almost perpetual oil booms in the previous several decades. The people were very oil conscious.

When Jack Crawford completed his 700-bbl. a day discovery on January 1, 1955, the boom, which resulted in a new state record for over-development of an oil field, was on its way. Before it was over, here's what happened:

Within 5 months, 210 wells had been completed in a pool estimated to cover only about 130 acres. These wells were drilled from a small 85-acre section of Huntington Beach, virtually all of it consisting of closely located small homes. Engineers agree 15 or 16 wells would have been the maximum necessary for economic development of the pool.



During the drilling boom, 45 rigs were working at one time in small backyard locations.

The pool also probably set some sort of record for rapid peak production and decline. It reached its peak production in April 1955 when it averaged 9,220 bbl. daily, only 3 months after its discovery. Then it went into its nosedive. Today, it is producing less than 1,000 bbl. daily.

Here's what it looks like today: Only 116 wells remain, and almost all of them are pumping only a few hours a day with an average daily production of 8 bbl. per well. The area is studded with idle pumping jacks. Workmen are moving out pumping equipment and new houses are being built.

Costly play . . . It doesn't take a computer to quickly figure out a lot of money was lost in the play.

The average 4,000-ft. well cost $60,000 to drill and complete. Added to that were items like $10,000 for production costs during the life of the well and for abandoning it. At an average crude price of around $2.30 a barrel during the life of most wells, and with an estimated 20,000-bbl. per well maximum recovery expectation, the operator was faced with a loss from the beginning.

But averages don't tell the true tale. The few operators who got in first made out all right. But even then, some experts estimate not more than two dozen of the wells will pay out eventually. The vast majority were overwhelming financial failures.

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paid on oil and gas totaled $2,421,711, to be distributed to the state and to oil and gas-producing counties.

Annual meetings of the API in 1961 and 1962 will be held in Chicago. The decision was made by the executive committee, which announced earlier that this year's meeting will be in Chicago.

A 20% cut in crude purchases has been instituted by Indiana Oil Purchasing Co. The proration, which is uniform in all areas where Indiana buys crude, is based on average purchases in January and cuts the company's total crude receipts from leases by 100,000 bbl. daily. A reduction in crude purchases has also been made by Esso Standard Division of Humble Oil & Refining Co. which is limiting buying in Mississippi to 85% of February runs (OGJ, March 7, p. 72).

United Cuban Oil has been reorganized and headquarters moved from Los Angeles to Houston. New board will be headed by Emmet O'Neal, chairman, and Stephen Wilhelm, vice chairman. James McBride, independent operator, is the new president. The company will strengthen U. S. production with purchase of a 51% interest in Crusader Oil & Gas Co., Pass Christian, Miss., and of Wyoming production. Company properties in Cuba have not yet been confiscated, but "final outcome is uncertain" according to Ted C. Jones, founder and former head of the company.

Notices of intention to drill in Kansas are off almost 21% so far this year. There were 340 notices filed with the Kansas Conservation Department during February, compared with 468 in the same month a year ago. The total so far this year is 678, down 20.7% from the same period in 1959.

A 3-for-1 stock split is planned by Kewanee Oil Co. Stockholders have approved an increase in the company's capitalization from 1,000,000 to 4,000,000 shares, of which 3,000,000 shares are earmarked for the split.

Superior Asks Gas Limit on Aneth Wells

• Company says 80-acre wells would be limited to 175 M.c.f. per day and gas-oil ratios restricted to 600:1 in order to cut down on underground waste.

SUPERIOR Oil Co. is taking a new tack in its efforts to curb underground oil waste it claims is occurring in Utah's Greater Aneth field.

Superior has asked the Utah Oil and Gas Conservation Commission that a daily gas limit of 175,000 cu. ft. be set for each 80-acre well. Any producers with gas-oil ratios in excess of 600 cu. ft. per barrel would be penalized.

The 500-well field now produces about 90,000 bbl. daily. Approximately one-half of the wells had ratios in excess of 700 cu. ft. per barrel when a study was made last August. About 80 had ratios in excess of 1,200 cu. ft.

Exact amount the oil production would be cut by a gas limit would require a field-wide study, but it has been estimated at 20,000 bbl. daily.

The commission had scheduled a hearing in Salt Lake City for March 15 to hear testimony on Superior's claim that present producing practices are resulting in loss of more than 20% of the recoverable oil. This has been postponed to May 15.

McElmo unit . . . Plans for unitizing the McElmo Creek area of Aneth also were brought out in the new petition.

Superior, which will act as operator for the 100-well unit, said a legal committee is drafting an agreement and plans are being made to start water injection immediately.

Humble Oil & Refining Co., Texaco Inc., Continental Oil Co., and Phillips Petroleum Co. are joining in the unit.

Superior is for the immediate start of water-flooding operations in the entire Aneth area. Most other operators believe that flooding shouldn't be started until reservoir pressures have declined to about 1,100 psi. Superior claims that ultimate oil recoveries will be lowered if the reservoir is permitted to decline to that level.

Gas problem . . . Superior told the commission the field is producing at average gas-oil ratios in excess of the original solution ratio.

Until pressure-maintenance operations can check the pressure decline and the increase in gas-oil ratios, the gas withdrawal limit should be imposed to curb oil withdrawals, Superior said.

The study made by Superior last August showed a few high-ratio wells in the White Mesa and Ratherford sections of the field. The great bulk, however, were in the Aneth portion.

Use of Fresh Water in Floods Is Contested

OIL AND WATER—two resources vital to the economy of New Mexico—are involved in a dispute in the southeastern part of the state.

Surface users of water are contesting a permit covering the pumping of Lea County underground basin water and its subsequent sale to water-flood operators.

Recently, the permit, which authorizes the use of 10,000 acre feet of water annually for secondary recovery projects in Lea and Eddy counties, was attacked at a hearing held by State Engineer Steve Reynolds.

The two legal issues involved:

. . . Is unappropriated underground water available for water-flood projects?

. . . Has the issuance of the water-flood operation permit left existing water rights unimpaired?

Adair Gossett of Carlsbad, and the Caprock Water Co., who hold water permits in Lea County, claim both of these tests have been met.

The opponents contend the basin from which the water would be pumped is closed and replenished at a diminishing rate by rainfall. They assert that the water level will be so low in 20 to 40 years that the basin will be empty for all practical purposes.

In addition, the opponents "commercial" use of the water for "speculative" purposes such as water floods is not a "beneficial use" in the sense that the term has been applied.

Gossett testified that the plans for water sale are not speculative but carefully planned to fill a need.

During the hearing, State Engineer Reynolds said he could not legally consider the opponents' contention that the fresh water should not be used for water-flood since brackish and saline water are available.

He added, however, that he personally opposes the use of fresh water for secondary recovery when impotable water is available. "I hope oil interests in southeastern New Mexico will be guided by a similar concept," Reynolds said.

"If not, they will invite restrictive legislation or other restrictions of their use of water."

Reynolds' ruling on the permit is expected after the filing of briefs.

Gulf Moving More People to Houston

GULF OIL CORP. is ready to move the last of its domestic operating departments — marketing — to Houston from Pittsburgh.

While the company issued no formal announcement, it was learned that J. L. Lenker, vice president in charge of marketing, is preparing to follow other department chiefs to Houston.

Within the past year Robert L. Boggs, vice president in charge of domestic production, and B. H. Barnes, vice president in charge of manufacturing, moved to Houston with their departments.

The exodus from Pittsburgh still leaves in the home office the general administrative offices and the headquarters for policy, planning, research, and finance. Gulf's foreign headquarters are in London and New York.

The marketing change apparently falls into the pattern developed by Gulf to separate operations from policy making.

Gulf currently has eight marketing divisions which have operated under the Pittsburgh headquarters and now will report to the Houston office. They are located in New York, Boston, Philadelphia, Toledo, Chicago, Atlanta, New Orleans, and Houston.

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Automatic Field Is Aim at Swan Hills

• LACT batteries of Pan American and Home Oil already are handling production from a total of 54 wells in Swan Hills region of Alberta. Their ultimate goal: A completely automatic operation.

THE IDEA of producing an entire oil field automatically is getting a stern test in the Swan Hills region of west central Alberta.

Pan American Petroleum Corp. and Home Oil Co. are leading the way there toward a completely automatic operation.

Their engineers foresee the day when the vast bulk of Swan Hills' crude will be produced day or night and moved by pipeline to refinery through equipment operating automatically.

A big start already has been made toward this goal. The operators are acquiring valuable technical know-how and data on equipment used under frigid operating conditions.

Home Oil is operating 14 of its wells automatically and could tie in another 22 wells with present equipment. Plans call for installing equipment to produce some 70 Swan Hills wells automatically in the near future.

Pan American currently has four lease automatic-custody transfer (LACT) batteries. A fifth is under construction, and a sixth battery is scheduled for construction as development in the field proceeds.

Pan American's existing LACT facilities now handle production from 7, 7, 12, and 14 wells, respectively, for a total of 40. The facilities, however, are designed to be expanded as required to meet increasing field development.

Automatic well-testing and data-gathering facilities are also being installed at one battery. Eventually fully automatic testing and data-recording facilities will be installed at all Swan Hills batteries.

The LACT batteries of both Home and Pan American are connected to the facilities of Federated Pipeline Co., a crude line which moves Swan Hills oil southeast into Edmonton. Its capacity is about 20,000 bbl. daily but can easily be stepped up to 75,000 bbl. daily by installing more pumping stations.

How LACT works . . . Pan American's LACT equipment gives a good example of what's involved in an automatically produced field.

The equipment controls five basic functions.

A float in the working tank actuates a switch starting the pipeline pump when sufficient oil is available for shipment through Federated Pipeline's p.d.-meter-type LACT unit.

The pump is shut down when the oil level in the working tank falls to a predetermined point.

The low-level float switch in the working tank is positioned to provide a minimum of 3 hours' weathering time.

The equipment also is designed to shut down oil shipments when the temperature of the oil drops below 45° F., or when the b.s. and w. content exceeds the acceptable limit. When a shutdown occurs due to low temperatures, the oil is automatically circulated through an indirect-line heater. When a high b.s. & w. content is detected, the wet oil is routed through the treating facilities and back to the working tank.

Automatic shutdown occurs when the oil level in the working tank reaches the safety float.

Some problems . . . The severity of Canadian winters imposed the first set of conditions on Pan American production engineers.

They found it advisable to house the LACT facilities instead of leaving them in the open. The buildings consist of a combination manifold and separator shelter, a heater shelter, and a combination treater-manifold and meter-run shelter. The heater is de-

WINTER weather imposes severe operating conditions on Swan Hills' LACT equipment. But field is being developed with a heavy emphasis on LACT units.

COMMUNITY of Swan Hills is little to look at just at present. However, in the mill are plans to build a model town and an all-weather highway into the rugged area.

signed to contain the automatic testing and data-gathering control panels.

The greatest operational problem experienced in the Swan Hills LACT operation has been deposits of paraffin. These have been especially serious in the well manifold and associated three-way valves.

Field men have found the most satisfactory operation of the three-way valves can be obtained by installing full opening valves which permit thorough hot-oil dewaxing of the manifold.

Savings . . . Pan American officials have an ideal spot in Swan Hills to go all the way with automatic operation of a lease including LACT facilities.

Pan American is able to put in the automatic equipment from the very beginning, so as to get maximum saving from use of such equipment. The Swan Hills field is a rugged, remote region where automatic and unattended operations also pay off big dividends in savings.

The savings are realized from a smoother, more centralized operation.

Pan American at present has had 48 wells drilled on its leases. During late 1959 and early this year a 10-rig drilling program was in effect. A continuous development program is currently being maintained with six rigs in operation.

Completions are flowing water free, with gas-oil ratios less than 500 cu. ft. per barrel. Daily per well allowables for Swan Hills field were 95 bbl. in December, 111 bbl. in January, and 89 bbl. in February.

All the wells are half-interest wells in partnership with British American Oil Co., with restricted potentials ranging from 200 to 600 bbl. daily. The Pan American-British American partnership controls 100,000 acres in the field, of which about 50,000 is expected to prove productive.

Drilling problems . . . In looking at other features of Swan Hills, logistics is the chief problem drilling men must conquer in that area.

The wilderness country 75 air miles northwest of Edmonton has been called the toughest oil men have encountered anywhere. Tall spruce and fir are so thick they repel all but the most determined woodsmen.

The heavily timbered hills are interspersed with muskeg which makes transportation a tough problem. Operators have one road into the area from Fort Assiniboine. It becomes rough going in the spring and after rains. Lease roads are cleared and

built at a cost of about $30,000 a mile.

The area is moving nearer to a year-round operation, however. In the past, drilling activity has been feverish in the winter when equipment could move over the frozen muskeg and snow-cushioned roads, but slowed to a near standstill in the spring and summer.

Operators this winter have been preparing drill sites on both the ridges and valleys so that drilling crews could work on the ridges this summer, and in the muskeg area next winter.

Other than headaches in transportation, supply, and weather, drillers have run into very few strange problems in Swan Hills. Cost to the contractor of drilling an average well runs from $50,000 to $60,000, exclusive of any profits.

One contractor gave the following rundown on his costs for his No. 1 well in Swan Hills (involving the move in) and the No. 2 well:

	No. 1 Well	No. 2 Well
Labor	$15,000	$ 9,600
Bits and reamers	5,000	4,300
Trucking	18,000	2,500
Drilling water	2,000	1,395
Fuel (diesel)	7,000	5,000
Special services	1,500	1,540
Camp, catering	5,500	4,000
Repairs, supplies	11,825	8,500
Supervision	5,500	3,500
Depreciation	8,600	6,500
Overhead	6,000	4,000
TOTAL	$85,925	$50,835

The initial well required 49 days from move in to move out and was drilled to bottom at 9,070 ft. and completed. The No. 2 well took 31 days and went to 8,975 ft. total depth.

When the extra labor and trucking costs of the first well are eliminated, contractor's costs on the two wells nearly uniformly become a factor of the days required. Contractors are finding drilling time is averaging from 27 to 30 days to reach the 9,000-ft. depths, barring any serious trouble. Their footage rates to the operators are now running $6.50.

When drilling contractors first went into Swan Hills, they experienced trouble with stuck pipe which caused an excessive number of fishing jobs. This difficulty has been largely corrected now by drilling straighter holes and taking all precautions.

New oil region . . . The Swan Hills region likely will keep development drillers and production men busy for some time.

Oil men estimate the drill already has developed a billion barrels of reserves. In the last 3 years, about 150 wells have been drilled in the region. Five productive pools have been developed with possibility they may require an additional 350 wells.

The pools and known data include:

. . . Swan Hills itself with recoverable reserves of about 500,000,000 bbl. Further extensions likely will expand this.

The Alberta Conversation Board last September received estimates that Swan Hills had original oil in place of 1.7 billion barrels in a productive area of 40,000 acres. The primary recovery factor was put at 20% which means original recoverable oil of 380 million barrels. Since then the productive acreage has increased to 60,000, giving oil in place of 2.5 billion barrels and half a billion barrels recoverable.

Other Swan Hills reservoir factors: Net pay 113.8 ft., porosity 8.29%, connate water 20%, shrinkage factor 0.744.

. . . Judy Creek, discovered by Imperial Oil about 6 miles south of Swan Hills production. It has possibly 60 million barrels of recoverable reserves. The pool now has about 16 producers on 12,000-acre productive area.

. . . Virginia Hills, which has a dozen producers but estimates on recoverable reserves have not been made public.

. . . Inverness pool, 5 miles north of Swan Hills, discovered by Kewanee this winter. It now has three producers, but Kewanee has revealed no details.

. . . Deer Mountain pool, 10 miles northeast of Swan Hills, which also has three producers drilled by Texaco and Consolidated Mic Mac.

Exploration men have found all five pools produce from the same formations.

A boom town . . . Swan Hills soon may boast another first—one of the fanciest boom towns on record.

There'll be no similarity at all between this town and the roisterous ones of the past flush oil regions.

In a farsighted move, Alberta authorities established a townsite just north of Pan American's "B" lease. The provincial government's rural and town planning board laid out a model community.

Swan Hills within a year probably will boast a new shopping center, hotel, service stations, office building, and the like. The planned town will prevent shanty-like buildings throughout the area and will concentrate the field's population in order to justify first-rate consolidated school facilities.

This construction will replace trailers and temporary buildings.

Monsanto Says Good Plant Sites Hard to Find

MONSANTO Chemical Co. is acquiring land for expansion in four states. Its latest real-estate venture is an option taken last week on 3,000 acres south of Houston, 25 miles southwest of its big Texas City petrochemical plants.

The company, headquartered in St. Louis, said it has made land deals in California, New Jersey, West Virginia, and Texas to develop industrial sites on navigable waters.

"These properties are getting rarer—and they're not getting any cheaper," a spokesman said.

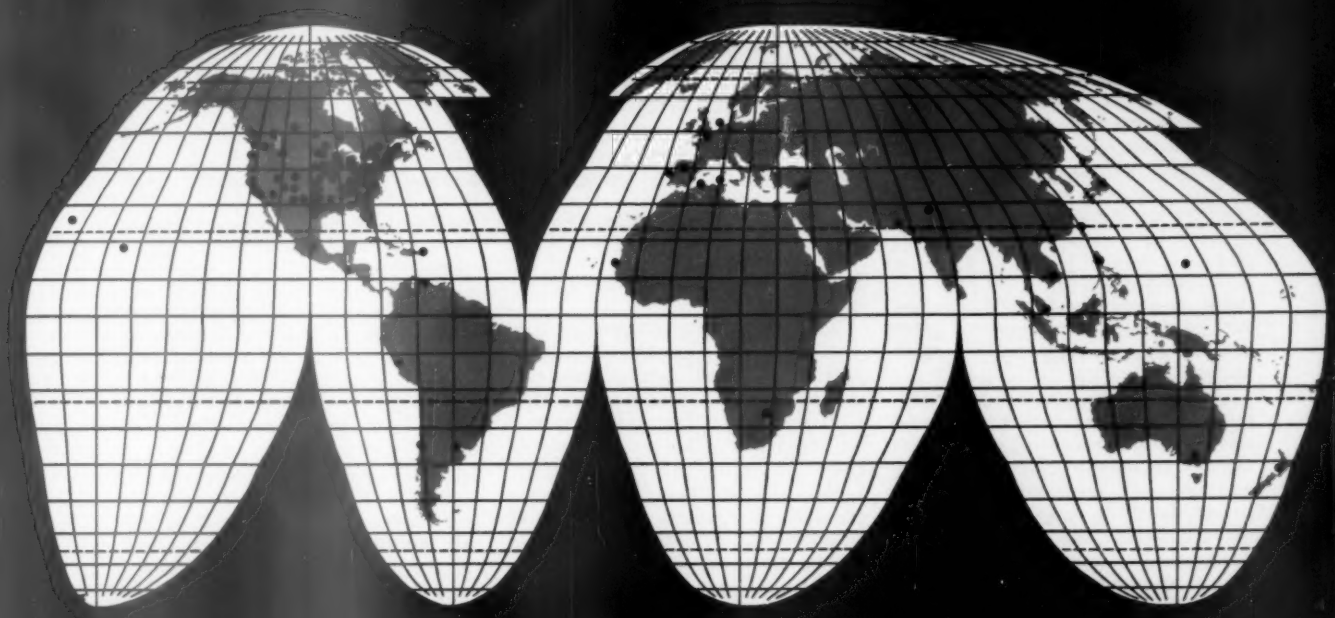
The company was not ready last week to announce specifically what it has in mind, but the Texas acreage probably will be used for additional petrochemical operations. At Texas City, Monsanto uses acetylene and ethylene basically to make styrene monomer, vinyl chloride monomer, acrylonitrile monomer, polyethylene, and methanol.

The 3,000-acre plot is located on Chocolate Bayou, about 8 miles south of Alvin in Brazoria County. The option, for 60 days with a 60-day renewal clause, was taken from Houston Farms Development Co. If plants are built there, they can be tied in easily with Texas City by pipelines.

Chocolate Bayou has a depth of 10 to 12 ft. and is navigable for barge traffic. Improvements may be made by the U. S. Corps of Engineers. Rail and highway improvements also are scheduled for the area.

Monsanto pointed out that the company has had trouble in the past with lack of space at its major plants in St. Louis, Springfield, Mass., and Texas City. At Texas City, the big operation is located on 133 acres, and 68 adjacent acres recently were acquired. Monsanto has a total of 22 plants.

The company said last week it will exercise its option on 300 acres of a 410-acre tract at Oxnard, Calif. It has recently taken an option on 650 acres in Newark, N. J., and it has bought 700 acres at Nitro, W. Va.



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Smogless Days Ahead for California

• Legislature is now in special session to hammer out some type of control measure for auto exhausts. It's a good bet the new law will require new cars to be equipped with afterburners by '62, and used cars the next year.

EFFECTIVE control of Los Angeles' biggest source of smog—the exhaust gases from millions of autos and trucks—is finally nearing realization.

Control devices capable of greatly reducing both the hydrocarbon and carbon-monoxide content of the auto exhaust are now available. Laws requiring their installation will be passed shortly by a special session of the legislature now under way in Sacramento.

Just when smog will cease to be a problem in Los Angeles can't be pin-pointed. But it is believed likely that 1962 models will have to be equipped with control devices before they can be sold in Los Angeles and other thickly populated areas. Earlier models probably will be required to be equipped with such devices by a year after that.

Smog is essentially a Los Angeles problem. Topographic conditions and the large number of autos are the main causes. Unburned hydrocarbons in the exhaust gases react with oxides of nitrogen (most of which also are contained in auto exhausts) to create "smog." The third ingredient is sunlight. By curbing hydrocarbons released to the atmosphere, some three-fourths of which come from autos, it is expected smog can be controlled.

Other large cities occasionally have smog, but their major problem is air pollution.

Extent to which the auto is gaining stature as a cause of air pollution is reflected in a recent statement of Arthur S. Flemming, Secretary of Health, Education, and Welfare. He urged auto makers to install crankcase "blowby" devices on all 1961 models instead of only on those destined for California. Thus, the steps being taken in California to curb the auto exhaust may soon be applied elsewhere.

Pending legislation . . . The California legislature, in a special session called to draft air-pollution controls, is considering two possible measures.

Principal difference between the two proposed bills is that one provides for local option whereas the other would apply equally in all 58 counties. The latter form is sponsored by the Los Angeles County Board of Supervisors.

Both measures would provide that:

. . . **Exhaust control devices** would have to be installed on all new cars sold in California within a year after a device or devices were approved by the state. All used cars would have to have devices installed within 2 years after purchase by a new owner, and all vehicles, regardless of classification, would have to have the devices within 3 years.

. . . **A board or commission** would be established to test and certify devices. Both proposals spell out general penalties for noncompliance and call for setting up test stations to periodically check autos.

Enforcing such a law offers monumental problems. For instance, in Los Angeles County alone, more than 3,000,000 vehicles would have to be checked annually. One expert estimated provisions would have to be made to inspect as many as 50,000 cars a day.

Two possible stumbling blocks appear in the path of the state proposals. However, neither is expected to seriously hamper final passage of some kind of state smog measure. The two blocks are:

. . . **A smoldering feud** between northern and southern counties over a variety of matters, including water usage and senate reapportionment, could foul up any measure which didn't include a county-option clause.

There are more than 30 counties, out of a total of 58 in the state, which have no interest in any state-wide anti-smog law. These counties are mostly in northern mountainous parts of the state.

. . . **Too severe** carbon-monoxide limitations in auto-exhaust standards could slow down development of certain types of devices otherwise effective in combating smog. Many experts contend CO plays no part in forming smog and shouldn't be a major consideration in setting exhaust standards. If tough CO standards are set, direct-flame afterburners will be at a distinct advantage over catalytic afterburners.

Control devices . . . With literally dozens of firms developing exhaust controls, the motorist will have a choice of several types of devices by the time he is required to install one.

It is believed at least three devices now available would pass the standards set by the state health department.

Among other things, these health department standards for ambient air quality and auto exhaust emissions include:

. . . **Hydrocarbons.** Limited to 275 parts per million by volume as hexane.

PIPELINE BRIEFS . . .

Plans for construction of a 90-mile gas line from northern New Mexico fields to Center, in Colorado's San Luis valley, have been abandoned, at least for this year, by Public Service Co. of Colorado. The company said lack of assured reserves and supply of natural gas caused the change of plans.

Crude oil from Scipio field of Michigan is moving through Marathon's recently completed 57-mile 8-in. pipeline from Mosherville to Samaria, Mich. At Samaria, the line connects with Buckeye pipelines extending north to Detroit and south to Toledo. A gathering system in Scipio field is completed and a second gathering system, servicing Albion and Pulaski fields, will be ready soon. O. R. Burden, Tulsa, was contractor for the system.

Further proof of sizable efficiency increase in gas lines from internal cleaning and coating with plastic was offered last week. In the first test on a 12-mile 24-in. line of Tennessee Gas Pipeline Co. near Refugio, Tex., deliverability was raised by 5 to 10%, depending on rate of flow. Some 4% was attributed to cleaning and 1 to 6% to coating in the cooperative industry test (OGJ, June 6, 1959, p. 108). A follow-up test has reproduced those significant results, Tennessee re-

. . . **Carbon monoxide.** Limited to 1.5% by volume.

Those restrictions call for an 80% reduction in current average auto exhaust hydrocarbon emissions and 60% in carbon-monoxide emissions.

In addition to the exhaust standards, the Los Angeles County Board of Supervisor's proposed state-wide measure spells out three main specifications it feels any smog device should meet before being approved. The board feels the device should:

. . . **Cost the car owner** no more than $100.

. . . **Be 80% effective** in curbing harmful emissions.

. . . **Have a life expectancy** of at least 25,000 miles.

Most recently announced device is the catalytic converter of Universal Oil Products Co. It has not been tested thoroughly, but UOP is confident it can meet the requirements limitations set up by California health authorities. UOP says the converter is capable of this performance for some 10,000 to 12,000 miles under typical urban conditions and with today's typical leaded gasolines.

The converter would be installed in place of a conventional muffler. Its price on a large-volume basis would not be greater than $50 more than a conventional muffler, UOP estimates.

A point of particular interest is that measured floorboard temperatures over the device have been found to be no higher than those encountered with a conventional muffler. Another most desirable characteristic is its short warm-up time—less than 3 minutes.

UOP's approach has been to develop a control device which is as replaceable as an oil filter. Air pollution control officials would know it was capable of satisfactory performance for a predetermined time (one year) on the average car. By requiring that the device be replaced annually, the many problems involved in periodic inspection and testing would be bypassed.

Truck afterburners—An afterburner for trucks and buses is already in service.

Some 50 Los Angeles buses have been equipped with a Barkelew Manufacturing Co. device for more than 4 years. There have been no malfunctions or failures and the devices are still performing satisfactoritly.

According to testimony given by a manufacturer at a recent air pollution control hearing, the afterburners have been eliminating about 97% of the hydrocarbons and some 80% of the carbon monoxide. Also on the plus side, they have increased mileage by 20%, from 2.8 miles-per-gallon to 3.4 miles-per-gallon. Only maintenance has been to change the spark plugs every 20,000 miles. Although these devices cost more because of the small order, the manufacturer said their cost in quantities of 500 would be about $220 each.

These afterburners are for vehicles of 550 to 700 cu. in. engine displacement. Whether they will work on the average auto is questionable. They are well designed for the stop-and-go driving of buses, which provides a rich mixture to the afterburner.

Car builders already have announced that 1961 cars destined for California will be equipped with devices to cut out crankcase vapor emissions. These vapors, called "blowby," account for an estimated 10 to 20% of the auto smog in Los Angeles.

Meanwhile, 3,530 Los Angeles county vehicles, and 5,000 city-owned vehicles will be equipped with anti-blowby devices soon.

Gasoline rule . . . The first legislative measure aimed at reducing auto-induced smog in Los Angeles goes into effect in the county July 1.

On that day, refiners will have to reduce the bromine number of gasolines sold in the county to a maximum of 30. On January 1, 1962, the bromine number restriction will drop to 20. Bromine number has to do with the olefinic makeup.

When the county bill was passed last summer, the oil industry didn't actively take a stand against it, but did express doubts about its effectiveness as an anti-smog measure. So the County Board of Supervisors ordered its air pollution control officials to participate in a joint study on the subject with the oil industry, the U. S. Public Health Service, and U. S. Bureau of Mines.

These studies currently are under way in Los Angeles, at the Public Health's labs in Cincinnati, and at the Bureau of Mines lab in Bartlesville. All are using six identical samples of gasolines provided by Los Angeles refineries. They range in bromine numbers from 10 to 50. Four are typical marketable gasolines while two are not commercial gasolines, being highly paraffinic in one case and aromatic in another.

The experiments are designed to find out what effect the bromine number of a gasoline has on the plant damaging and eye irritating qualities of its exhaust. A report on the joint study is to be made to the county July 1. Meanwhile, Los Angeles refiners have been busy with multimillion dollar modifications of processes to turn out the bromine number restricted gasolines.

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ported last week, further encouraging gas lines to adopt the practice to boost flow and reduce maintenance.

Contract to lay 130 miles of gas line for Shamrock Oil & Gas has been awarded to Vaughn & Taylor Construction Co., Odessa, Tex. The contractor will complete a 49-mile 20-in. line from Shamrock's McKee plant to Amarillo in April. Construction began last week on 54.5 miles of 16-in., 5.5 miles of 20-in., and 20 miles of 2 and 4-in. from east central Ochiltree County, Texas Panhandle, to the company's Stewart compressor station. The project will be completed in June.

Contract for a 35-mile 18-in. line from Shell's Sheridan plant below Houston to Wharton, Tex., has been awarded to Sheppard-Geiger Construction Co., Corpus Christi, by Houston Pipe Line Co. The line will take 50,000 M.c.f. daily of gas from the plant for delivery to Shell's Deer Park refinery and chemical plant.

A 5-mile 16-in. line and a 15-mile 12-in. line are planned by Mississippi River Fuel Corp. from Collinsville, Ill., to St. Jacob, Ill. A 2,000-hp. compressor unit will be installed at Collinsville. The project is pending FPC approval.

A 30,000-hp. station expansion is planned this year on Interprovincial Pipe Line Co.'s Edmonton-Toronto crude line.

Also for Pipeliners . . .

IN THE NEWS: Superior asks 175 M.c.f. per day gas limit to Aneth wells and gas-oil ratios of 600:1 (p. 104) . . . New pipelines moving crude from Angola fields (p. 119) . . . Shell-BP plan pipeline to new tanker terminal in Nigeria (p. 119).

A complete list of pipeline projects is carried in the last issue of each month. Current projects are covered in Pipeline Briefs.

PLUS SPECIAL SECTION on natural-gas and gas pipelines (pp. 121-180).

Depletion Approved for Shut-in Royalties

- **First court decision on this point opens the door for many other royalty owners to file a tax claim.**

AN IMPORTANT tax case, which affects persons who collect royalty payments on shut-in gas production, has been lost by the federal Government.

These royalty owners can, under the new ruling, take the 27½% depletion allowance.

The ruling, however, was not a complete victory for the plaintiff because it held that depletion could not be taken on rental payments received for acreage outside the producing area on the same lease.

Mrs. Flora I. Johnson, Edinburg, Tex., and her two sons, Clarence G. and Hal W., brought the lawsuit against the internal revenue director. They sought recovery of $13,494 paid in taxes from 1954 through 1956 on payments received from 8,165 acres leased in Hidalgo County.

U. S. Federal District Judge Joe Ingraham ruled at Houston that the Johnsons are entitled to collect a refund of about $2,400. This represents excess taxes paid on royalties received on 320 acres surrounding each of the shut-in wells on the lease.

Taxes paid on revenue from acreage lying outside the shut-in well tracts will not be refunded because the depletion allowance does not apply, Ingraham held.

The court decision is the first to clarify the point of law regarding depletion and shut-in royalties. The government had not decided last week whether to appeal the decision.

Superior Oil Co. had been making payments of $5 per acre to the Johnsons for the lease and had drilled four gas producers, all of which were shut-in during the 1954-56 tax period.

In the Johnson case, the judge said, the 320 acres surrounding each of the four wells qualifies for shut-in royalties, while the other acreage comes under a delay-rental classification.

In granting the Johnsons the right to take percentage depletion for shut-in royalty, Ingraham said that such payments are similar to bonus payments for leases. The Supreme Court has held that the depletion allowance can be taken for bonus revenue, although there is no production. It is considered advance royalty.

Shut-in royalties are normal on gas-producing leases and are not deducted later when royalties for actual production are paid.

Attorneys on both sides of the case said the opinion probably will affect a large number of royalty owners in the country. Some of these have paid taxes under protest and will be in a position to obtain refunds if the Ingraham decision stands. Others could file amended returns and claim refunds.

However, the U. S. Attorney's Office also pointed out that persons who have taken the depletion allowance on revenue from acreage outside the area of a shut-in well may be assessed for back taxes.

Scipio Trend Test Blows Out, Burns

THE FIRST major well fire in the Southern Michigan Trenton play was touched off by a cracked light bulb following a blowout at 4,063 ft.

The fired well is a wildcat between Pulaski and Albion fields. It is Perry Fulk's 1 Rosenau-Trader in Section 1-4s-4w in southeast Calhoun County.

The blaze started when gas-charged fluid kicked back as blowout preventers were closing and cracked a light bulb. The preventers were then closed, but gas from a broken connection was re-ignited by burning side curtains on the winterized rig.

The wild well was making an estimated 30,000 M.c.f. of gas. The fire destroyed the Calvert Drilling Co. rig, two automobiles, and a logging trailer. The drilling crew was not injured.

Paul N. (Red) Adair of Houston was called in to supervise attempts to control the well.

The test is 2 miles southeast of Albion pool and 2 miles northwest of Pulaski field, all on the original Scipio trend.

Again pointing up the erratic Trenton formation, the well is a diagonal offset to a dry hole drilled by Fulk last year. The burning well is Fulk's fourth test in a 1½ mile square. *(For a report on the Scipio trend see p. 239.)*

PROCESSING BRIEFS . . .

Independent Industrial Workers Association, which won the recent union representation election at Esso's Baton Rouge refinery, voted better than 78% in favor of accepting a new 2-year contract. No general wage increase was involved.

An ethylene plant will be constructed at Sweeny, Tex., by Phillips Chemical Co. The new facility is to be adjacent to Phillips' existing ethylene plant, which now is being expanded to raise capacity to 290 million pounds annually. This enlargement will be completed in the second quarter of this year.

A petrochemical plant for production of dodecylbenzene will be built by Witfield Chemical Corp., a new company jointly owned by Richfield Oil Corp. and Witco Chemical Co. It will be built adjacent to Richfield's Watson refinery in Los Angeles.

A new steam generator will be installed and the gas-recovery unit at the DX Sunray refinery, Duncan, Okla,. will be modernized at a cost of $1,600,000. Procon, Inc., of Des Plaines, Ill. will handle construction. The generator will be ready May 15 and will be put in operation at the annual cat-cracker turnaround.

Also for Refiners . . .

IN THE NEWS: Indiana Standard workers at Sugar Creek end long strike, but contract still unsigned (p. 98) . . . Virginia service-station operators fight proposed gasoline-tax increase (p. 102) . . . Monsanto says good plant sites hard to find (p. 108) . . . California legislators drafting smog controls in special session (p. 110).

PLUS THIS TECHNICAL REPORT: How world's biggest crude-distillation unit operates (p. 201).

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Phillips Looking to Chemicals for Big

• Ultimately, half of its net profits may come from chemical operations. In fact, Phillips thinks it might well become the first oil company to be transformed into a chemical firm.

THE GROWING importance of petrochemicals to the oil industry received some unusually strong emphasis last week.

It came in the disclosure that Phillips Petroleum Co. expects that "as much as half of the company's net profit could ultimately come from chemical operations."

Phillips has been a pioneer in petrochemical development and is one of the top producers of such products today. The extent of its operations is shown in the accompanying table. It lists the products Phillips makes by principal categories. It also shows the capacity for each when this year's expansion plans are completed.

Since Phillips made $104 million in 1959, the fact that it expects to net 50% from its chemical operations means that some day these operations will return more than $50 million annually. In 1958 only a half dozen other oil companies netted this much on all their operations.

Another significant comparison is Phillips' record last year with those of other oil companies. Its net was up more than 22%. This was more than half again as high as the average of 97 producing and refining companies as reported by the First National City Bank of New York.

Still another is Phillips' rating with investors. It is, for example, one of the 10 most favored stocks in monthly investment plans. Only two oil companies are in the first 10. The other is Standard Oil Co. (N. J.). Phillips was one of the few oil companies whose stock price range was higher in 1959 than in 1958.

Observers, both in financial circles and in the oil industry, attribute Phillips' current good showing, in large measure, to its petrochemical operations.

Investment study . . . Phillips' role in petrochemicals is part of a lengthy analysis of the company put out last week by the First Boston Corp.

It points out that Phillips has carried on research in the utilization of hydrocarbons since 1925. This research has paid off handsomely.

Phillips projects an increase in earnings this year of 10 to 15%. In making the projection, this statement is added: "The contribution of chemicals to earnings, already important, appears on the threshold of significant increase."

One of Phillips' first departures from normal oil company practice was its early concentration on natural-gas liquids. It pioneered the development of markets for LPG in the '20's and today is the top producer and marketer of LPG.

Phillips management "early recognized that natural-gas liquids potentially are more valuable, barrel for barrel, than crude oil," First Boston Corp. says. Its experience with natural-gas liquids led the company into petrochemicals. Since the two are complementary, Phillips is more integrated in this respect than most oil companies.

Its annual research expenditures are now estimated at about $10 million.

Its store of technical knowledge so acquired has paid off in unusual ways. For example, Phillips gave the Venezuelan Government atomic energy and plastics manufacturing technology in partial payment for concessions in that country.

Expansion abroad . . . Phillips is making other efforts to extend its petrochemical operations beyond the confines of the U. S.

It has developed overseas markets for its products and is considering the construction of plants in these markets. It already has a half interest in carbon-black companies in France, Italy, and South Africa.

Early last year it formed a foreign sales and development department to sell the company's crude oil, prod-

PREFABRICATED station is loaded on two flat cars for shipment . . .

Texaco Canada Utilizes Prefab

THE SWING to prefabricated service stations has gone as far north as Canada.

Texaco Canada, Ltd., recently placed two portable stations in operation which were designed and developed by Petro Canada, Ltd. They are full-size units with built-in plumbing, wiring, fixtures and equipment. Fabricated in two steel sections, the stations have a total floor area of 48 by 28 ft. Each of the sections weighs about 9 tons and can be shipped from plant to site by road, rail, or water. At the site,

Growth

ucts, chemicals, patents, and technical services and to develop manufacturing and distribution projects abroad. Last November it organized an international department to consolidate all foreign operations.

One source of revenue from abroad is the company's licensing arrangements. Five foreign companies, in Japan, Germany, Italy, France, and Great Britain, are using Phillips' linear project polyethylene processes under license. Another, in Brazil, is building a plant to do so.

Some 36 companies here and abroad are using Phillips' patented processes. Revenues from the sale of licenses, royalties and technical services go a long way toward footing the bill for the company's substantial annual bill for research.

The investment . . . Phillips has spent large sums in commercializing its processes.

From 1947 through 1959, it has spent more than $200 million on chemical operations. They break down something like this: synthetic rubber and carbon black, $65 million; fertilizers, $55 million; plastics, $50 million; various chemicals, $20 million, and special gas-liquids facilities, $20 million.

Despite its big investment in petrochemicals, Phillips does not segregate them as such. All told, seven departments and subsidiaries either produce or sell petrochemicals. Many raw and intermediate materials from the same plants end up at various times as either a petroleum product or a petrochemical product. Phillips looks on each new venture, however classified, on its own merits, based on a calculated rate of return.

These operations led K. S. Adams, Phillips' chairman, to make the statement recently that "we expect to lead the oil industry in transformation into a chemical company." Actually, Phillips is looking beyond petrochemicals.

It has been active in the atomic energy field since it was picked by AEC to operate the materials testing reactor at Arco, Idaho, in 1950. In 1955 it set out to search for uranium, found it, and now has a contract to supply uranium to the AEC.

This gives it an added source of revenue and is increasing its knowledge in a field that may some day be competitive with petroleum.

Phillips' preeminence in LPG, its leading role in petrochemicals, and now its interest in atomic energy give Phillips a broad base. It's a good insulation against the vagaries of oil markets, plagued by an oversupply of crude and refined products.

Phillips' Chemical Capacity

Product	Annual Capacity
Ammonia, tons	398,000*
Ammonium sulfate, tons	401,500
Ammonium nitrate, tons	142,000
Nitric acid, tons	130,000
Nitrogen solutions, tons	55,000
Philblack, pounds	350,000,000
Ethylene, pounds	290,000,000
Marlex polyethylene, pounds	75,000,000
Butadiene, tons	112,000
Synthetic rubber copolymers, long tons	113,500
Methylvinylpyridine, pounds	5,400,000
Paraxylene, pounds	5,300,000
Sulfur, long tons	88,000

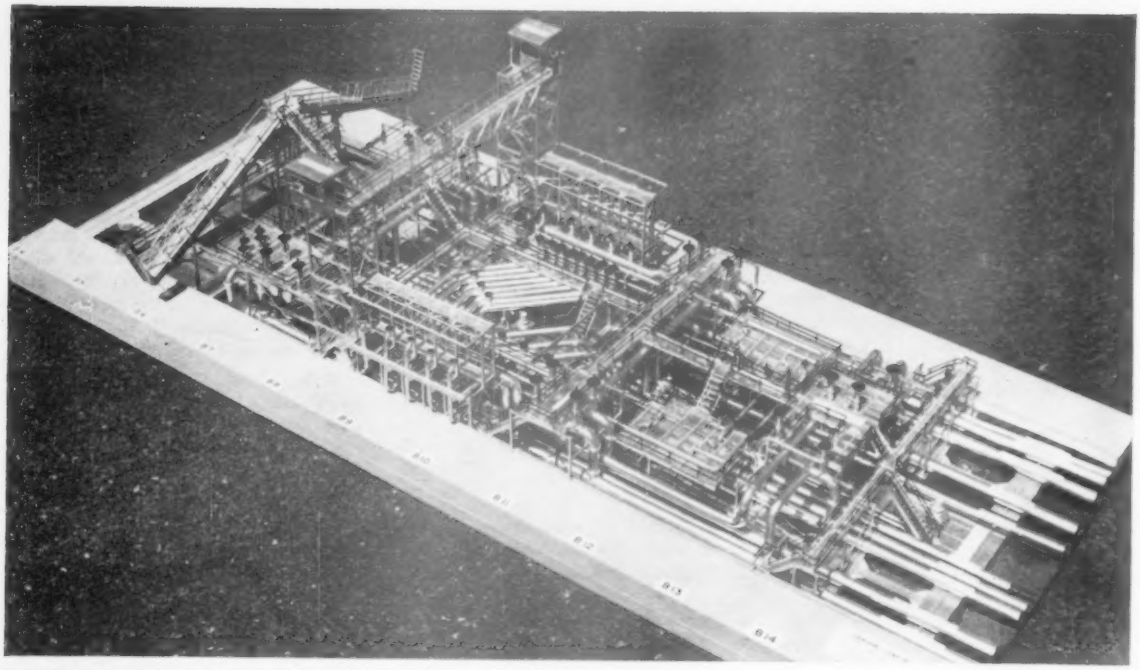
*Not including 37,000-ton interest in 51%-owned unconsolidated subsidiary.

THEN MOVED to site by trailers . . .

AND ERECTED and ready to open 48 hours after arrival.

Service Stations in an Experimental Program

the two sections are bolted together to form a complete service station. The manufacturer claims that the stations can be put together or taken apart in 48 hours. The prefabricated stations already erected by Texaco are at Pepentigny, Que., and Long Branch, Ont. The portable stations are prototypes and a part of an experimental program being carried out by Texaco to incorporate improved service-station design and construction techniques in the company's Canadian outlets. The stations were built by Canadian Vickers, the designing company's licensed Canadian fabricator. The stations have attracted the interest of a number of Canadian petroleum marketers and Petro Canada, the developer, plans to conduct an inspection tour of them this month.



TANKER LOADING facility was built first as this model. Construction of the operating unit is now nearing completion in Lake Maracaibo, Venezuela, for Shell. It will handle 500,000 bbl. daily.

Models Solve Producers' Problems, Too

PRODUCTION men are adapting the refiner's scale models to offshore construction.

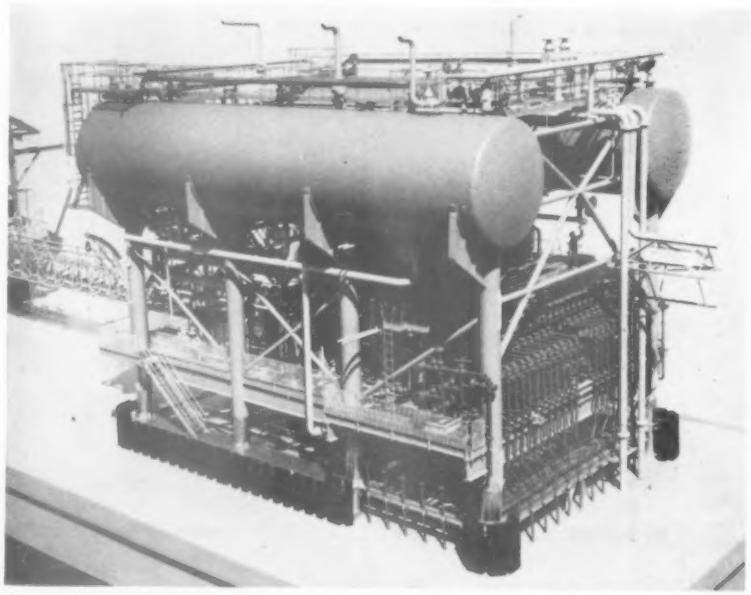
The use of scale models in production has lagged because of the simplicity of most installations.

Now, with multiwell offshore platforms common and construction costs soaring, models are cutting costs and helping to plan, design, and fabricate offshore platforms.

The models not only serve as a check on the drawings but let the designers view the structure in perspective. They are built to exact scale, usually ⅜ in. to 1 ft., and have all piping, valves, fittings, vessels, platforms, and walkways in position.

Designers can spot interferences not readily apparent on the drawings. They can improve valve positions, increase accessibility to equipment, and eliminate superfluous pipe and structural members.

The model also helps to familiarize the contractor with the appearance of the finished project and to train operating and maintenance personnel.



SEPARATOR PLATFORM was built first as a 26-in. model. The operating facility will soon be under construction for Superior Oil Co. in Lake Maracaibo.

The most recent application of a scale model to an actual job is Superior Oil Co. of Venezuela's No. 2 Flow Station on its Lama concession in Lake Maracaibo. Pipe Line Technologists, Houston, built the model.

The flow station is the heart of an underwater producing complex of 24 wells. It consists of a 58 by 70 ft. platform containing the gas separators, and a 50 by 60 ft. platform for pumping equipment. The platforms are in about 90 ft. of water.

J. Ray McDermott Co. has set the underwater portion of the platforms. The abovewater part of the platforms will be constructed in four sections in the United States and then barged to Lake Maracaibo. The contract for the abovewater part has not been awarded.

Below-Market Sales Bring Protest

• Venezuela's Perez Alfonzo says Superior, San Jacinto, and Signal have been selling Maracaibo crude below posted price. He says he will stop such sales, but doesn't know yet just how he will do it.

VENEZUELA'S minister of mines and hydrocarbons is faced with a perplexing problem and is looking for a practical answer.

Dr. Juan Pablo Perez Alfonzo cried foul last month when he discovered that three of the economically hard-pressed newcomers in Lake Maracaibo are selling crude at well below posted prices. He said publicly, and in print in Caracas, that this was bad for Venezuela and vowed he would put a stop to the practice.

Last week he said a complete investigation had disclosed that three companies have sold 577,000 bbl. of Maracaibo crude to a novel New Jersey "in bond" refinery at prices ranging from $1.50 to $2 a barrel. He admitted he doesn't know what, if any, action will be taken, then added:

"The practice will be definitely stopped to protect the price of our oil in the international markets."

The dilemma . . . Industry sources commented privately that there is nothing the minister can do under present Venezuelan law to prevent any company operating in the country from selling its crude at any price it can get. This obviously is his problem.

Perez Alfonzo took over the ministory of mines and hydrocarbons a little more than a year ago when Romulo Betancourt became the president of Venezuela. Since that time he has preached the gospel of stable prices and conservation of Venezuela's oil in a world of unstable crude prices and oversupply.

Dr. Perez Alfonzo says his investigation reveals that San Jacinto Petroleum, Signal Oil, and Superior have sold a total of 577,000 bbl. of Maracaibo crude to Interamerican Corp., which is associated with Petroleum Separating Co.

Petroleum Separating is operating a part of the old Bayonne, N. J., Tidewater refinery, which was disposed of in 1956. The crude is processed in bond and exported to foreign markets, sidestepping the need for an import quota under present U. S. regulations.

The Venezuelan minister said San Jacinto has accounted for 112,000 bbl. of the crude so far, Signal, 317,000 bbl., and Superior, 148,000 bbl.

Dr. Perez Alfonzo admits he has no quarrel with the basic idea, but he's highly disturbed because the crude is being sold at below posted prices. The income which Venezuela receives from oil is dependent to a fair extent on the price paid for its oil. This income is already dwindling because of curtailed operations in the country. Companies say this can be attributed to the increased 10% tax bite on the industry which Venezuela sprang overnight more than a year ago.

Royalties paid Venezuela by the operating companies are based on price postings for equivalent crude oils in Texas, but income taxes which make up the bulk of the country's oil income are based strictly on profits.

Sales of Venezuelan crude below posted prices are nothing new. Nearly all the companies who entered Venezuela for the first time in 1956 and 1957 and paid whopping big bonuses for new concessions found themselves without markets by the time they had established production from the high-priced leases. In order to move production and make these expensive concessions pay out, most of them began shaving crude prices.

Dr. Perez Alfonzo's problem is basically this: In order to avoid wholesale erosion of Venezuelan oil prices, he must pressure or persuade companies to hold the line. He has to do it at present with no legal backing.

Unverified reports in Caracas last week were that the three companies involved in the ministry's investigation offered to post prices for their crude—at the same level they are selling it—to resolve the problem. Few believe this will be acceptable to the perplexed minister.

Stanvac Drops Out of New Papuan Wildcat

AFTER sinking more than $70 million into a frustrating exploration play in Australian New Guinea, Standard-Vacuum has decided against putting up cash for a new Papuan wildcat.

The new well, at Iehi, still will be drilled by Stanvac's partners, British Petroleum and Oil Search, Ltd. Each will put up $1.8 million, making the venture without help from their American partner for the first time in a 22-year program.

Stanvac officials would not say whether the firm was pulling out of Papua altogether or whether it will have an interest if the new wildcat makes a commercial find.

The major partners were on the verge of giving up New Guinea 2 years ago, but a 1,000-bbl.-daily well was brought in at Puri. Later drilling indicated the find was noncommercial.

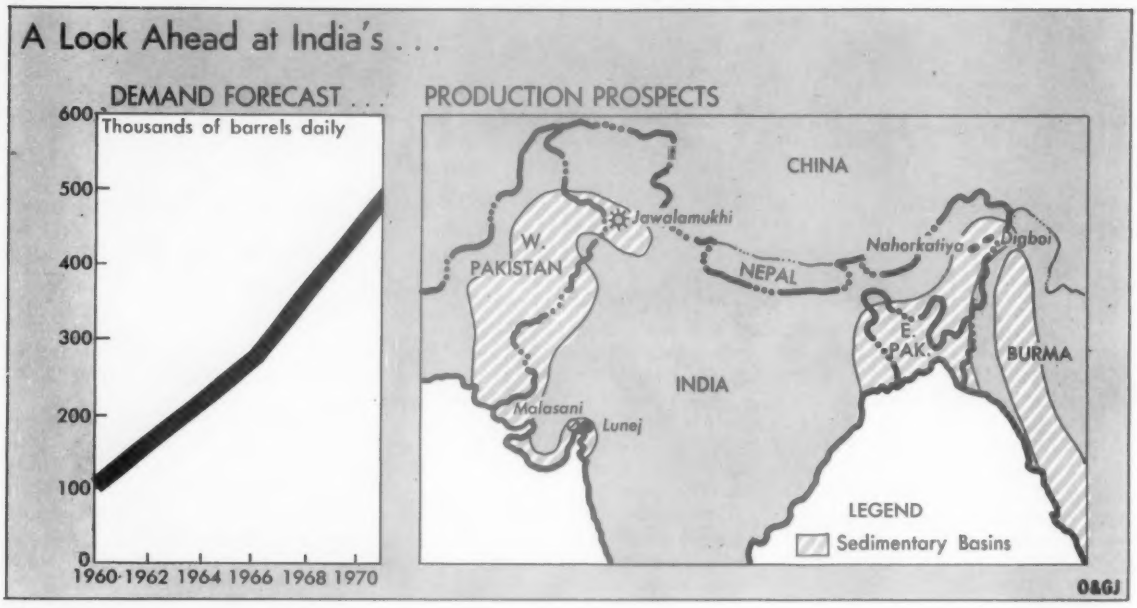
New Aussie subsidy . . . The Australian Government, meanwhile, is expanding its subsidy program for petroleum exploration.

Geophysical surveys and well logging are now covered.

Twenty-five out of 27 exploration projects approved for aid in the latest round of grants are either seismic or gravity-survey programs. This type of work has become eligible for government help under a revised oil law that previously limited subsidies to stratigraphic drilling.

The new law permits the government to help defer costs of surveys and logging and increases the rate for strat drilling where there is no indication of structure. The latest group of subsidies will total nearly $1.4 million. This, plus grants approved earlier for work this year, will total $2.3 million.

The government started to help pay for drilling costs 3 years ago in an effort to keep exploration alive in Australia and Papua, Australian New Guinea.



India Shooting for Oil Expansion

• With a revised oil law as the lure, the Indian Government is attempting to get foreign firms to come in and help develop local industry. The country faces a soaring demand over the next 10 years.

OIL MEN and officials of the Indian Government are in huddles this month, and if they come to a meeting of minds, the country's oil industry may have a new look in the most important 10-year period in its history.

Major companies are showing a definite interest in India's invitation to negotiate for concessions under a revised oil law. Reports from New Delhi are that the government has heard from British, French, Japanese, and Italian, as well as U. S.-based firms. All are private integrated companies, except for Italy's government-owned ENI.

India rewrote its oil law and invited foreign firms to participate in exploration because of a realization of the immense cost involved in developing a local industry.

Oil companies have been eager to take a look, because in an era of oil surplus, India still has a combination of factors that make it attractive. These are good exploration prospects and a big potential demand.

India has set March 31 as its deadline for concession offers. The new law is extremely flexible, and most major points are left open to negotiation between the government and companies (OGJ, Jan. 25, p. 137).

Demand to soar . . . As in other countries facing rapid industrialization, India can look forward to a growing foreign exchange bill for oil imports.

Consumption of 6 million tons of oil this year, or about 120,000 bbl. daily, will be more than double demand in 1950. The Indian Government expects that consumption will reach 280,000 bbl. daily by 1966. It foresees as entirely possible a demand of 500,000 bbl. daily by 1971.

Present crude production of 8,500 bbl. daily fills less than 8% of local demand. Domestic production will rise to 65,000 bbl. daily when a pipeline outlet is completed from Nahorkatiya and Moran fields in Assam. But the added production will still leave a large and growing gap between output and demand.

Nahorkatiya . . . Most of the Indian peninsula is covered by a shield with thick sediments on the northern, northwestern, and eastern fringes. The country's only commercial production is in the eastern, or Bengal Basin region with the discovery of Nahorkatiya field in 1953.

The initial find, made by Assam Oil Co., a subsidiary of Burmah Oil Co., was completed at a total depth of 11,715 ft. Since then, 51 wells have been completed, of which 44 are producers, two are gas wells, and five are dry holes.

Most of the wells will average 300 to 700 bbl. daily, but many have tested 2,000 bbl. daily or better. The best well, No. 48, tested 5,500 bbl. daily on open flow, and yielded 600 bbl. daily through a ¼-in. choke.

Production is from sands in the Barail series, which at Nahorkatiya is divided into three divisions. The upper, argilaceous division, varies from 200 to 1,200 ft. A middle division composed of alternating sands and shales is about 500 ft. thick. A lower, more arenaceous, division is about 1,700 ft. thick. Oil is found in the uppermost bed of the lower division, and in the sands of the middle division.

Five main producing zones have been identified. But detailed correlation from well to well is uncertain because of lateral variation.

The crude is 33°-gravity, has a pour point of 90° F., and contains 11.5% of recoverable wax.

Pending construction of a long-distance crude line from Nahorkatiya, small amounts of crude are shipped north to a refinery at Digboi field. Digboi is in a state of decline. More

than 1,000 wells have been drilled in the field since the 1880's, and more than 600 are on production at any given time. But half the output comes from 30 wells.

A dozen wells have been drilled at Moran, 25 miles west-southwest of Nahorkatiya. Seven are producers, one is a gas well, and four are dry. The producers are in the same class as Nahorkatiya wells.

Government program . . . A good oil show was encountered last week for the fifth time in the Cambay area of western India.

Oil was encountered at 5,100 ft. near Malasani in a government program being carried out with the help of Russian and Romanian personnel and equipment. The pay was the shallowest so far in any of the five wells.

The Cambay area offers the best prospect for the government's Oil and Natural Gas Commission. Until the recent revision of the oil law, India had staked its hopes on finding and developing major production through its own efforts. Oil has been found at Lunej in the Cambay area, and gas at Jawalamukhi, in Punjab. So far, however, the commercial prospects of these areas have not been determined.

Stanvac program . . . Stanvac has drilled eight dry holes on a concession in West Bengal Basin, and it now feels it has a better chance of finding gas than oil on its block. Its next two wells will have gas as the objective.

Stanvac obtained its rights in 1953 before India shifted its emphasis to a government-controlled exploration program. The agreement with the company, however, has not been arbitrarily modified.

Oil India . . . Assam Oil Co.'s assets in the Nahorkatiya and Moran areas have been taken over by Oil India, Ltd., a rupee company in which the government has one-third interest. Oil India also will own a 260-mile 16-in. pipeline from Nahorkatiya to Gauhati, Assam, and a 460-mile 14-in. extension to Barauni, Bihar.

A 15,000-bbl. refinery at Gauhati, and a 40,000-bbl. plant at Barauni will be owned by a government company, Indian Refineries, Ltd. The plants are being built with Russian and Romanian aid.

Existing refinery capacity is owned by private companies. Burmah-Shell has a 50,000-bbl. plant, and Stanvac has a 38,000-bbl. plant at Bombay. Caltex has a 13,500-bbl. refinery at Visakhapatnam on the east coast of the country.

The combined capacity of the three plants is slightly less than current demand.

Lines in Africa

. . . will link two Angola fields with refinery.

NEW small-diameter pipelines will start moving crude early this year from new field discoveries in Angola.

Petrofina is building a 3-in. and 4-in. pipeline from two finds in the Quissama Game preserve, southeast of its existing production on the coast of the southwest African colony.

The best of the discoveries, at Galinda, tests 600 bbl. daily through a 1/16-in. choke from 7,054 ft. An earlier well in the same area found oil, but lacked good pressure.

A 3-in. line is being laid from Galinda to Bon Jesus, on the south side of Cuanza river, where the scond field has been found. A 4-in. line will run from Bon Jesus to a pipeline already connecting Benfica field and Luanda, where Petrofina operates a small refinery. The first stepout to the Bon Jesus discovery is in progress.

Petrofina produces about 1,200 bbl. daily from Benfica, Luanda, and Cucuaco fields, all of which are located near the coast, in the vicinity of the town of Luanda. Most of the output is from Benfica.

Refinery Slated Near Manila

SHELL REFINING CO. (Philippines) will start work soon on a 25,000 bbl. refinery 75 miles south of Manila.

The local affiliate of Royal Dutch-Shell expects to open the plant within 2 years. Downstream processing facilities will include a Platformer.

The plant will be built at Tabango in Batangas Province. The site is on sheltered, deepwater Batangas Bay, where Caltex already operates a 22,000 bbl. refinery.

Shell will own 70% of the refining company, capitalized at more than $21 million. Local Philippine interests will hold the remaining 30%.

Another Philippine project is a 25,000 bbl. refinery on Bataan being built by Stanvac. Gulf Oil has permission to build a 10,000 to 17,000 bbl. plant on Luzon.

Reds Plan "Giant" Refinery

HORN-TOOTING for a new refining project in Hungary indicates refinery technology behind the Iron Curtain still is somewhat behind the West's.

The Communist government describes a proposed 60,000 bbl. plant as "a giant, highly automatic refinery . . . so automatised that only 1,500 workers will be required."

Even so, the plant will be a big step forward for the country, where combined capacity of all plants is less than 20,000 bbl. daily. The refinery is planned to take advantage of a new crude pipeline from Russia into eastern Europe. Work will start next year at a site 15 miles south of Budapest.

Pipeline Expansion

. . . and terminal slated by Shell-BP in Nigeria.

A PIPELINE to a new tanker terminal in Nigeria will run for 10 of its 18 miles along the bed of Bonny River.

The 12-in. line is being laid from a temporary terminal at Port Harcourt to facilities under construction at Bonny. It will be an extension of a small-diameter system already carrying crude from Shell-BP Development Co. fields to Port Harcourt.

The final 10 miles of the extension are being laid along the river bottom, with the depth at one point reaching 70 ft. African Construction Co. is contractor for the $700,000 project.

Tankers up to 18,000 tons will be able to pick up crude at the new West African port. The drawback to the Port Harcourt terminal is that only shallow-draft vessels can navigate that far up the river.

The new line will carry the 30,000 bbl. daily, expected from Nigerian fields by the end of the year. Output may reach 90,000 bbl. daily in 5 years.

Petrochemical Plant Planned

ANOTHER American oil company is entering the French petrochemical industry by forming a partnership with a local French firm.

A California Standard affiliate will have half interest in an aromatic derivative plant at Donges, on the Atlantic Coast of France. The plant will produce 8,500 tons per year of paraxylene made from feed stocks drawn from Antar refinery, owned by one of the French partners.

Socal's interest will be held through its subsidiary, Oronite Chemical Corp., which in turn has set up a French company, Californie Atlantique. The remaining half interest will be held by Soc. Petrochimique de l'Atlantique. The owners are an affiliate of Antar, with 35%; Pechelbronn, 20%; Progil, a local chemical company, 25%; Serco has 10%; Sofibanque, 5%; and Worms Bank, 5%.

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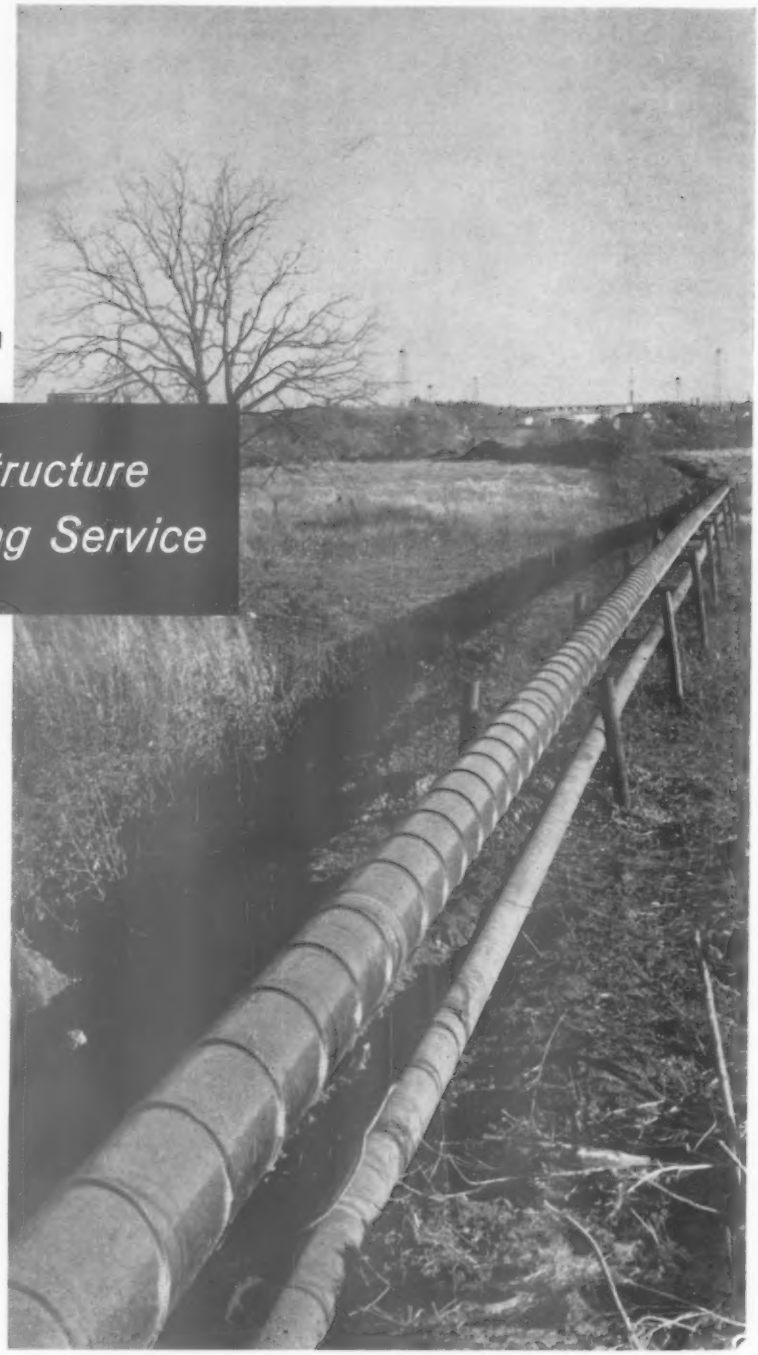

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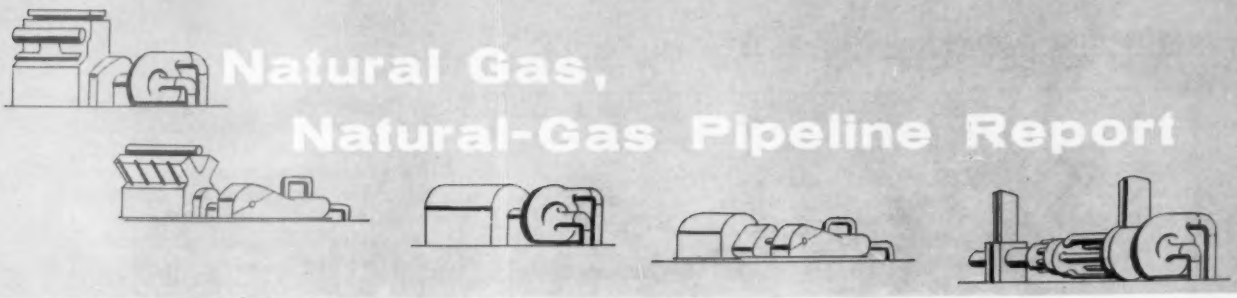


Better controls, more automatic operation, pace progress of natural gas

BY TOM C. HEARD

. . . since 1951 an application engineer in General Electric's user industry sales department. His specialty is the oil and gas-pipeline industry. He joined the company in 1947 on the engineering test program. In 1948, Heard became an industrial control design engineer. He moved to the Denver office in 1949 as an application engineer.

Heard graduated from University of Texas in 1946 with a B.S. in electrical engineering.

THE NATURAL-GAS industry has been one of the world's major growth industries of the past quarter century. Every year there have been major new pipelines, newly opened gas fields, new storage or distribution systems—and each time a new facility was just ready to operate, consumer demand created the need for new facilities. With such rapid growth many natural-gas companies did all they could to keep up with demand, and concentrated on the primary function of getting the gas to the consumer as quickly and safely as possible.

In the last few years, however, there has been a marked increase in effort toward better controls and more automatic operations. This increased activity toward automation has a number of interrelated causes, primarily:

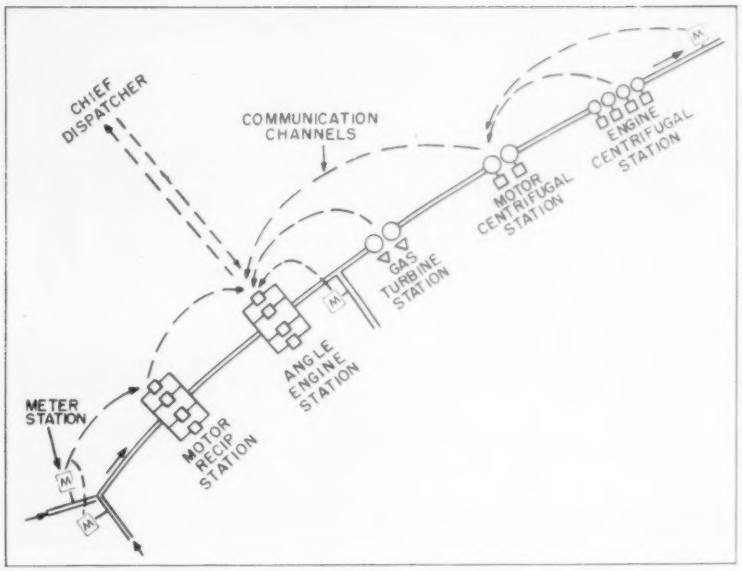
1. The sizes of gathering, treating, transporting, distributing, and storing facilities are now so large that more efficient and rapid means of control of the gas-handling equipment is necessary. The time constants of the newer, more efficient equipment are short so that automatic protection and control is inherently a requirement for use of this equipment.

2. As in all of industry, the installed cost of basic equipment and its operating costs have increased considerably, and more efficient use of the equipment is the only way to operate profitably within the government-regulated sale of gas to the consumer. More efficient operation naturally leads to continually increasing ratio of automatic to manual control. A human's efficiency can be improved beyond a certain point only by use of better tools with which to work.

3. The natural-gas industry, although itself a major developer and cause of more automatic basic machinery and equipment, has been able to use many of the recent scientific and engineering achievements of other industries, including the military. Some examples are communications, data handling, and data processing.

The word automatic is defined as "self-acting or self-regulating." Many functions in the gas-pipeline industry are automatic. Fig. 1 shows a hypothetical pipeline (with various types of compressor stations for demonstrative purposes) in which the following operations are automatically controlled, typical of the industry today:

- **Main-line valves**—pressure or flow regulating.
- **Compressors**—pressure, flow,



HYPOTHETICAL PIPELINE with modern controls and various types of compressor stations. Fig. 1.

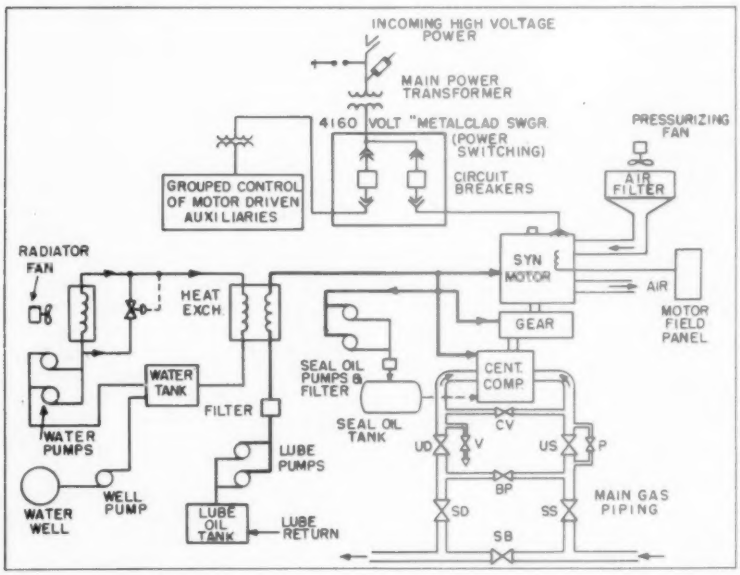
speed, or horsepower regulation.

- **Compressors and drives**—automatic start-stop sequences.
- **Compressor and drive cooling systems**—automatic temperature regulation.
- **Compressor and drive lube and seal-oil systems**—automatic pressure, and level regulation.
- **Auxiliary electric systems**—automatic voltage and power regulation.
- **Auxiliary air systems**—automatic pressure regulation.
- **Fuel-gas systems**—automatic pressure control and fuel governing.
- **Equipment alarm systems**—automatic fault detection and corrective systems.
- **Remote supervisory control**—automatic condition indication.
- **Metering, logging**—automatic local and remote data indication, logging, and computing.

Almost every gas system has a large number of these automatically controlled functions; some pipelines have all of them. It would be a hard job to determine the worth of doing these individual jobs automatically, for accurate evaluations are not possible. But how many gas companies could afford to do without those automatically controlled functions which they are now using?

Going back to a strictly manual operation would mean adding considerably more personnel to unappealing jobs, slower reaction and operating times, poorly protected equipment, inefficient and burdensome data handling, and a poor competitive-service position. From this viewpoint today's automatic controls are seen to be very worth while.

Today's pipeline engineer and his management are often busily concentrating on their own particular project. But it is a revealing and interesting procedure to stop and view the panorama of controls in the gas industry today, and plot the trend of controls. Major developments in controls are evolving rapidly, and more sophisticated control systems are coming—it's a certainty.



SYNCHRONOUS-MOTOR-DRIVEN centrifugal compressor with basic electric power, water, lube oil, seal oil, and gas systems. Fig. 2.

Compressor and Drive Control

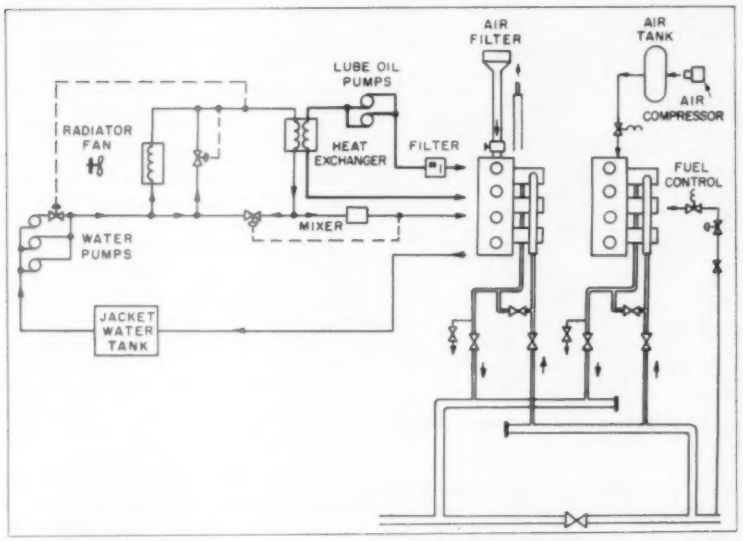
Compressors and their drives are the most expensive and important dynamic equipment in the gas-transportation industry, and the evolution of their automatic control has resulted in complex systems. The four major types of compressor and drive combinations all have general automatic-control functions which are similar in general, but widely different in detail according to the compressor-unit peculiarities.

It is significant to note that the first compressor stations to use automatic start-stop sequence controls may now appear somewhat "overdone" or elaborate. The first installations were careful and studious attempts to avoid loopholes of protection, and some felt the result was an excess of protection. Many engineer-hours have gone into efforts to simplify these controls and eliminate "bugs," and early complaints of complexity have subsided due to experience and increased familiarity with this equipment.

The accepted practice now is to install automatic (or semiautomatic) start-stop sequence control equipments with new compressor installations. Since this trend began, one fundamental idea has evolved—that a compressor station is an integrated system and not just a conglomeration of devices and functions.

Most control devices and their standard manner of use in these automatic systems are reliable enough

"At least two components must fail, with relatively remote chance of simultaneous occurrence, before the machine is unprotected."

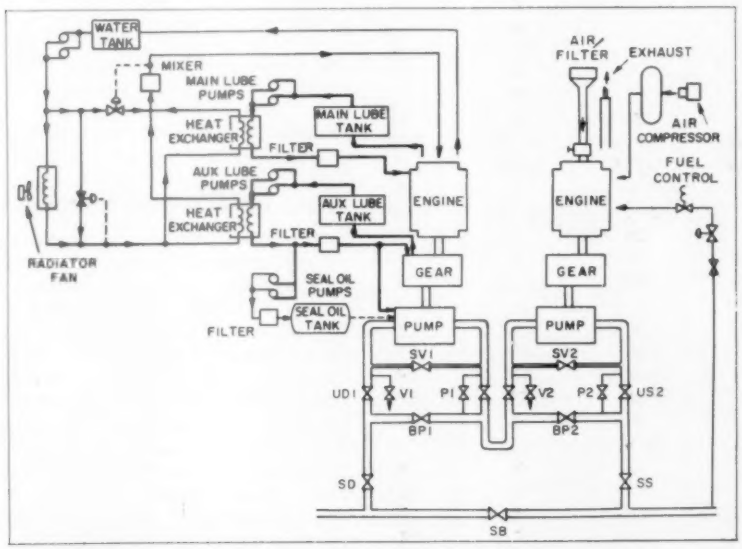


ENGINE-RECIPROCATING compressors with basic gas, water, air, lube, and seal-oil systems. **Fig. 3.**

for long periods of relatively trouble-free use. However, strict preventive-maintenance programs are necessary for the best reliability—and even then there are occasional parasitic failures (most often where a device is newly applied).

This fact, plus the importance and expense of the equipment to be controlled, has led some to adopt a system-wide philosophy which may be stated: "It must require more than just one control component failure to leave a machine unprotected. At least two components must fail, with relatively remote chance of simultaneous occurrence, before the machine is unprotected." Of course there are conditions for which there can be no real early-warning protection, such as the very rapid deterioration of a crankshaft, turbine bucket, or compressor wheel. Such occurrences, infrequent as they may be, are machine failures which announce themselves.

But in many automatic stations today one might purposely destroy a lube pump, an overtemperature-alarm relay, or an electrical connection, any of which may shut down the station or compressor eventually. However, the compressor and drive would still be protected, because an auxiliary lube pump would automatically start, and an overtemperature trip relay would "back up" the first relay, or loss of voltage would result in "fail safe" control-circuit action. Millions of dollars worth of equipment and the expense of long down times create a need for this sort of philosophy.



ENGINE-CENTRIFUGAL compressors with basic gas, water, air, lube, and seal-oil systems. **Fig. 4.**

Compressor-Station Auxiliary Systems

Fig. 2, 3, 4, and 5 show typical compressor-station drive and auxiliary systems for four types of compressors in use today. Each of these is different in detail according to the compressor unit, but each is generally similar in function and use.

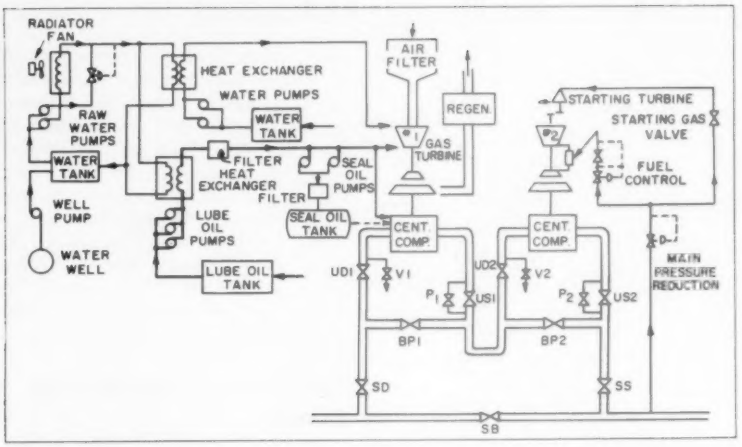
In the electric-motor station, Fig. 2, the main incoming high-voltage power is transformed in the main substation to a suitable utilization voltage for the large synchronous-drive motors, say 4,160 volts. This power is switched to the motor by heavy-duty circuit breakers.

This motor circuit breaker is controlled by start-stop sequence relaying so that it starts or stops the motor only when all other related functions are operating properly. Special protective relaying also automatically operates this breaker to avoid damage from such occurrences as power-system failure and reclosure, overload, short circuits, underfrequency, etc.

As in many of the other types of stations, most of the smaller auxiliary pumps, fans, and similar equipment are motor driven. The electric power is further transformed by an auxiliary power transformer to a lower voltage (480 volts) suitable for this equipment. All of the electric-power-handling components (including motor starters and breakers) are automatically protected by overcurrent relays, undervoltage trip devices, etc.

One special automatic protective system used with the electric-motor station is the ventilating-air system. The motor enclosure is pressurized through ducts from outside fan and filter, so that any escaped gas will not be allowed to leak into areas of electrically conducting parts. The motor cannot run or start without air-pressure as detected by discharge-duct air-pressure switches.

A typical station cooling-water system is shown for the reciprocating



GAS-TURBINE-DRIVEN centrifugal compressors with basic gas, water, lube, and seal-oil systems. Fig. 5.

compressor-engine station, Fig. 3. The cooling water, unless a river or large stream is nearby for open-system use, is stored in a larger tank from a well pump. Water is circulated from fan-cooled radiators for heat removal to a lube-oil heat exchanger and to engine jackets, and back to the tank.

Most stations use standby water pumps and radiator fans which are manually or automatically started and stopped according to cooling-water temperature. Further regulation is obtained by the regulated opening of a valve bypassing the fan-cooled radiators, or by adjustable-speed fans. Where a higher inlet-water temperature for engine-jacket water cooling is required, a special mixing of lube-cooling water discharge and fan-cooled water is employed. Many of these systems are self-regulating entirely, requiring only a starting and stopping signal.

The lube and seal-oil system of an engine-centrifugal station, as in Fig. 4, is normally fully automatic. Many of these stations, relatively new in the industry, use a unitized cooling and lube system—each engine-gear-centrifugal has its own separate system from fan-cooled radiator to engine.

In Fig. 4, the lube oil is pumped by main and standby pump through the lube-oil heat exchanger to the engine and gear. These pumps may be shaft drawn from the gear or engine, or may be electric-motor driven. Standby pumps are usually motor driven and operate according to pressure-switch operation.

The engine-driven centrifugal seal-oil system is similar to those of motor and turbine-driven centrifugals, basically automatic in motors. One of two seal-oil pumps normally takes lube oil at 20-30 psig., and boosts it to a pressure somewhat higher than compressor-casing gas pressure. This seal oil is filtered and pumped into a seal-oil tank where it bleeds into the compressor shaft seal to oppose gas leakage from the compressor.

A special seal-oil level regulating system, peculiar to each compressor manufacturer, automatically maintains proper seal-oil level, usually bypassing the seal-oil pumps with a regulating valve. If level falls too low the second seal-oil pump is started according to the level switch.

One of the important automatic auxiliary systems in the gas-turbine station, Fig. 5, is the starting-gas system. An expansion gas turbine takes gas either directly or through a pressure-reduction valve, and cranks the turbine. The starting gas is controlled by a valve automatically opened and closed in the starting sequence.

Fuel-gas pressure is regulated by an automatic pressure-reduction valve system and governor-controlled fuel valve. These fuel-system valves are ultimately electrically controlled for preset automatic starting sequences.

TABLE 1—TYPICAL AUTOMATIC PROTECTIVE FUNCTIONS

Function—	Type of station: Recip. engine	Engine centrif.	Motor centrif.	Turbine centrif.
A.c. volts low	A	A	A	A
D.c. volts low	A	A	A	A
High motor power demand	....	....	SR	....
Power system malfunction	A	A	SR/SL	A
Motor temp. high			SL	
Ventilating pressure low			SR	
Excessive vibration	SL	SL	SL	SL
Lube temp. high	A/SR	A/SR	A/SR	A/SR
Lube pressure low	A/SR	A/SR	A/SR	A/SR
Lube level low	A	A	A	A
Seal-oil pressure (level) low	....	A/SR	A/SR	A/SR
Seal-oil pressure (level) high	....	SR	SR	SR
Bearing temp. high	SL	SL	SL	SL
Jacket-water temp. high	SR	SR	....	SR
Jacket-water pressure low	A	A	....	A
Cooling-water level low	A	A	A	A
High gas temp.	SR	SR	SR	SR
High discharge pressure	SR	SR	SR	SR
Low suction pressure	SR	SR	SR	SR
Surge	....	A	A	A
Overspeed	A/SL	A/SL	....	A/SL
Control-room pressure low	A	A	A	A
Fire	SL	SL	SL	SL
Air pressure low	SR	SR	SR	SR
Exhaust temp. high	SR	SR	SR	SR

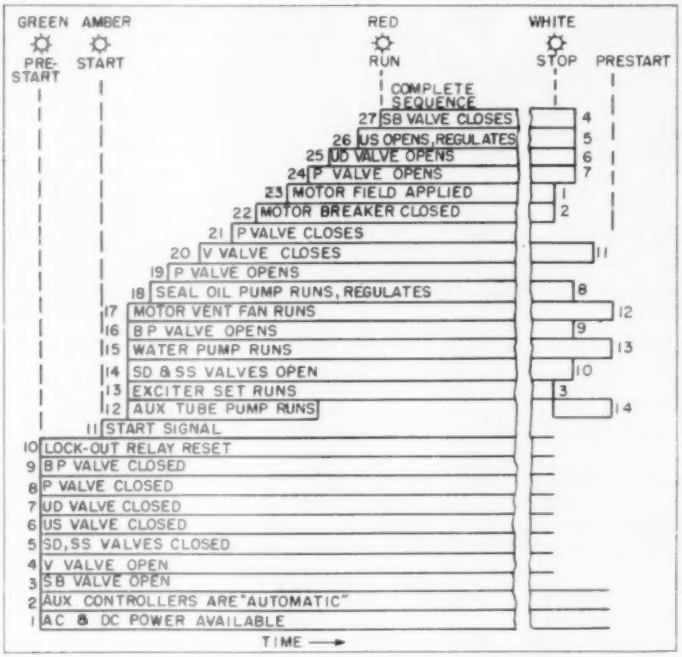
A—Alarm only. SR—Shutdown-restart. SL—Shutdown-lockout.

Alarm and Shutdown Functions

Because of the modern automatic or semiautomatic compressor station, it is necessary to have a monitoring system to advise remote or local operators of malfunctions. This is normally done by annunciators on the operator's control panels, receiving signals from protective temperature, vibration, pressure, speed, etc. relays. The annunciator sounds an alarm and either drops a printed tab or illuminates a printed window to define the unusual condition, and thus leaves a record of the unusual condition.

A trend in the industry is to classify the alarm conditions, such as (A)

"The difference between a modern station with fully automatic sequencing, and a modern station with operators performing step-by-step starting, might be $5,000-$25,000."

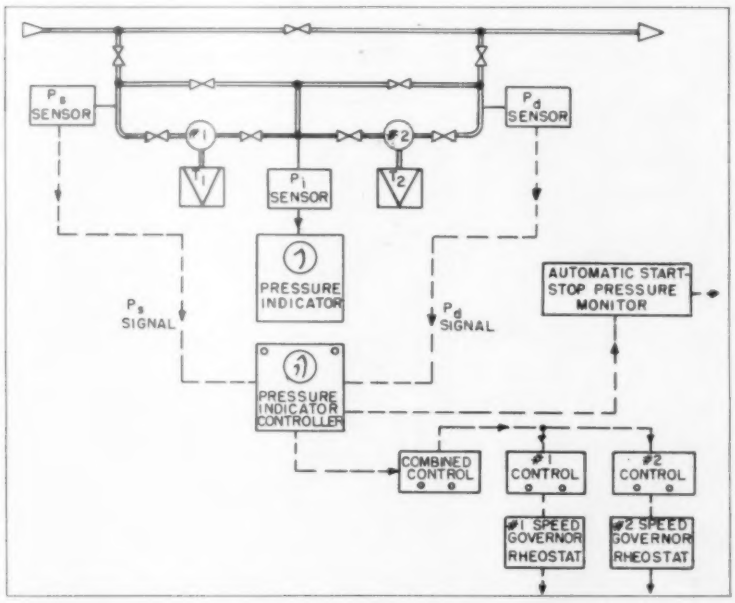


START-STOP sequence for synchronous-motor centrifugal compressor. Fig. 6.

alarm only, (SR) shutdown of the compressor unit but with provision to restart if the unusual condition is cleared, and (SL) shutdown and lockout to prevent restarting of the equipment until an operator inspects and manually resets the tripping device.

Table 1 shows some of the more common alarm conditions for the major types of compressor equipments, and possible classifications of these alarms. There may be many more in any particular station, but this is peculiar to the philosophy of each particular station design engineer. In one modern remote-controlled station with, say, three engines, there may be 100 alarm functions.

The engineer who first encounters such a long list of protective devices may feel them to be more trouble than they are worth. However, experience and device development have resulted in systems of very little trouble and maintenance. In total these protective devices for a particular station may cost $5,000 - $10,000, but this amount may easily be saved in down time or equipment repair.



AUTOMATIC STATION pressure control is shown for two gas-turbine-centrifugal compressors. Fig. 7.

Start-Stop Sequence and Valve Operation

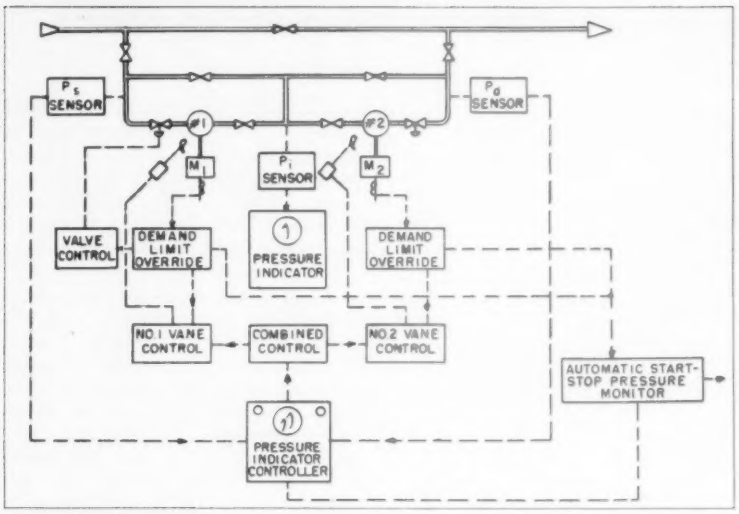
For the remote-controlled station, it is expedient to have the compressor completely start and stop automatically once the start or stop signals have been given. This allows a minimum amount of remote signal transmission and special telemetering.

Even with stations locally controlled, however, most modern installations of all types are being installed with automatic or semiautomatic starting sequence controls. The difference between a modern station with fully automatic sequencing, and a modern station with operators performing step by step starting—might be $5,000-$25,000.

This difference does not include such items as power-operated valves and protective devices assumed to be used in either case. For the manual station, the additional operators' salaries alone might cost the difference, and the station with automatic sequencing would have faster and more reliable operation.

Fig. 6 is an automatic sequence diagram for synchronous-motor centrifugal-compressor station. Steps 1 through 10 are conditions normally existing when the unit is shut down, but ready for operation. After step 11, when the start signal is given, the auxiliary lube, seal oil, water, and ventilating systems operate under their own system regulating controls. Then follows the actual forced sequence starting. The control circuitry is arranged so that the result of each step is the signal for the next step, and in some cases timers are used for a check.

Although Fig. 6 is for a motor-



AUTOMATIC STATION pressure control for motor-driven centrifugals. Fig. 8.

gear-centrifugal compressor unit, similar sequence charts can be made for any type of compressor unit. These are helpful in the beginning steps of planning an automatic starting sequence. Experience and care are needed to design the control circuitry for efficient and fail-safe operation—so that at least two control-equipment failures must occur simultaneously before the compressor unit is unprotected.

Special Automatic Operating Controls and Equipment

In addition to the widely growing and accepted practice of automatic compressor start-stop sequencing, the gas-pipeline industry has been developing and discussing some special automatic operating controls. Again, this increased use of automatic controls is the means to an economic end, and not the end itself.

The purpose is to reduce the effort required by operators and free them from tedious mechanical procedures for other matters, to have a close but speedier degree of control for avoiding costly undesirable conditions, and to provide controlled limits for the most economical operation. Also, more local automatic controls mean less communication channel use for remote-controlled stations.

Automatic Station Pressure Control

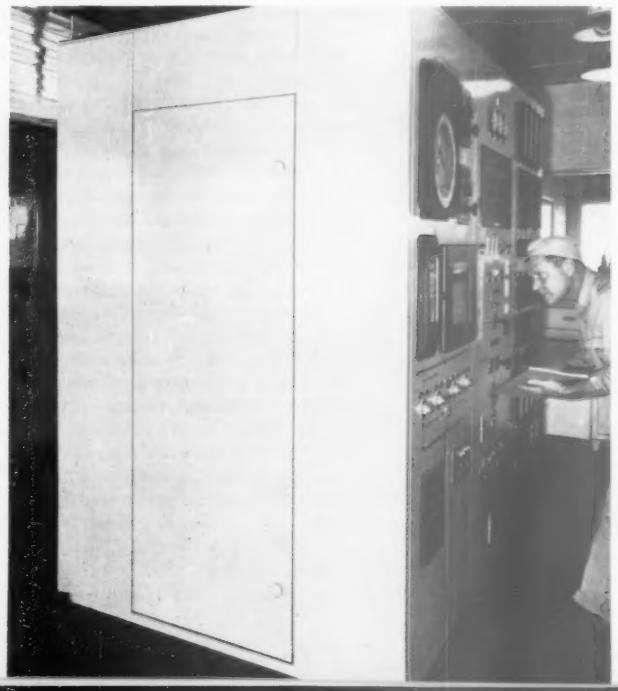
Most gas-pipeline dispatchers instruct station operators to operate the equipment in order to hold a given station discharge pressure. In many instances this instruction is not changed for long periods of time and the station operator spends a great deal of time merely checking and adjusting to see that the equipment is operating to hold this pressure and not reducing suction pressure too much.

These watchdog functions are easily handled by automatic-control equipment in some types of stations. Refer to Fig. 7 for an example of automatic-station pressure control where two gas-turbine-driven centrifugal compressors are used.

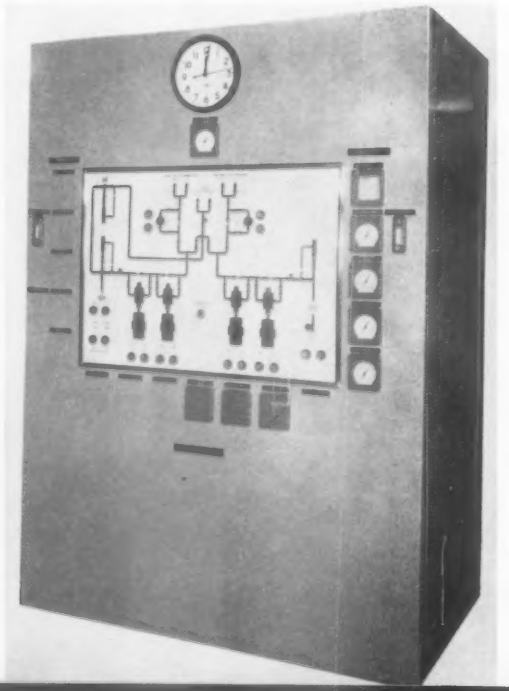
Here, the usual measurement and analog display of station suction, intermediate, and discharge pressures is indicated. The suction and discharge-pressure signals are also used for control purposes. The pressure indicator-controller, a commercially available and standard equipment, receives these two signals and normally produces a single output signal proportional to station discharge pressure. The combined control unit compares this signal with a discharge-pressure set point selected by the operator.

If the station discharge pressure is not close to the setting, the combined control will produce an error signal to the individual (No. 1 and No. 2) control units. These in turn cause a change in the compressor-drive gov-

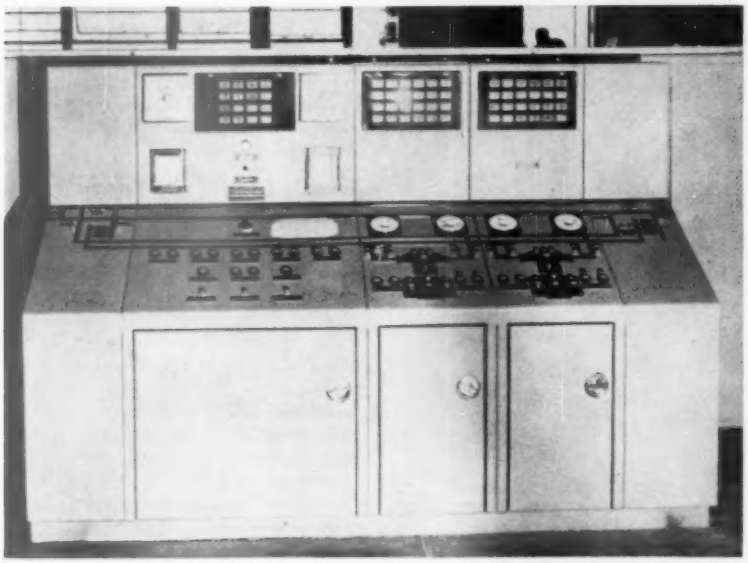
DUPLEX-TYPE control panel with end doors for walk-in access to wiring and connections. Fig. 9.



DUAL-SWITCHBOARD-TYPE control panel, with access from rear doors. Fig. 10.



"On constant-speed centrifugal-compressor units, and especially where they are to be remote controlled without attendants, automatic surge warning or detection equipment is useful."



DESK OR CONSOLE-TYPE control panel with sequence relays and devices mounted elsewhere. Fig. 11.

ernors for speed increase or decrease in order to bring the station discharge pressure back to that of the set point.

If the suction pressure falls below a preset value, however, the indicator controller overrides the discharge-pressure signal and produces an output signal that causes speed reduction of the compressors. This reduces station throughput and allows suction pressure to rise.

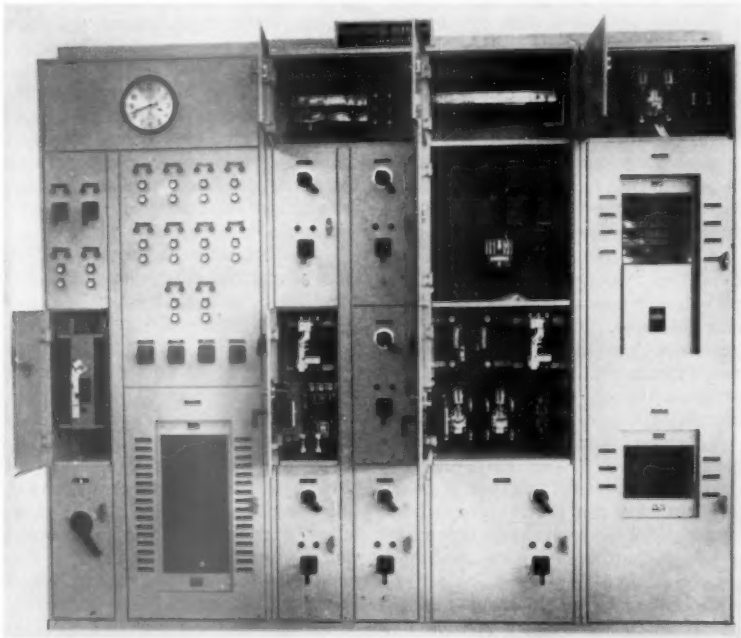
Such a system cannot be expected to hold pressure to better than 1% accuracy (9 psi. out of 900 psi.), but the repeatability can be within 2 or 3 psi. This system is in use with gas-turbine-driven centrifugals and could similarly be used with engine-driven centrifugals.

Fig. 8 shows a station pressure-regulating scheme for motor-driven centrifugals. In this case the motors are constant speed, and so pressure adjustment is made with motor-operated guide vanes. These same motor-operated guide vanes can be used to limit high motor power-demand charges, by operating to reduce motor load when an input-power metering system signals excessive power.

With reciprocating compressor engines, automatic station pressure control would probably be more complicated because there are two means of control (speed and pocket settings). Such a controller may have to be a computer to represent the unit operating characteristics.

With automatic station pressure control two special conditions should be automatically monitored. First, excessive load should be automatically annunciated or automatically corrected. For instance, a gas turbine can do this with its normal temperature override governor function.

Second, where centrifugal compressors are operating in series in a station and one shuts down, automatic controls should be employed to idle the remaining units or open bypass valves to prevent surge. After a time, the remaining compressors can again be loaded when they can span the reduced station pressure ratio.



AUXILIARY CONTROL panel from which all station auxiliary power may be controlled. Fig. 12.

Starting-Power-Demand Control

A power-demand limit control is sometimes used for the motor-centrifugal unit when it is being started. After the suction and discharge valves are first opened, the first centrifugal carries a high flow (at low pressure ratio)—resulting in a high load on the motor. Only after the pressure ratio has increased and flow has been reduced will the motor load return to normal.

Some pipelines have installed a specially developed control scheme to regulate compressor suction-valve position according to motor electric power. Following the unit startup, this control allows the suction valve to open only as the pressure ratio increases across the compressor and motor power is below a preset maximum.

Another pipeline merely used a slow-

timed opening suction valve (time adjustable) so that by experience the opening time was selected to prevent excessive loading of the compressor.

Automatic Centrifugal-Compressor Surge Protection

If the pressure and flow conditions of a centrifugal compressor are deviating greatly from rated (too-high ratio, too-low flow), unstable flow through the compressor will result. This condition, commonly known as surge, can cause violent vibration and equipment damage. On constant-speed centrifugal-compressor units, and especially where they are to be remote controlled without attendants, an automatic surge warning or detection equipment is useful.

By reference to a typical centrifugal compressor characteristic, it may be observed that a compressor surges below a certain value of Q/N (inlet flow divided by speed) ratio. Speed is easy to measure, but inlet flow is not easily or inexpensively measured with sufficient accuracy.

Another approach is that developed and being used by one pipeline. The philosophy here is to actually detect surge by measuring its characteristic effects. Surge was found to result in discharge-pressure pulsations of a frequency peculiar to a particular compressor installation. The equipment measured and produced a signal proportional to the frequency of pulsation for a predetermined time.

This prevents false action of the control equipment when "normal" pressure changes occur on the compressor. If the pulsation frequency is correct to indicate surge, the magnitude and duration are sufficient, the equipment will sound an alarm and take corrective action. This corrective action can be the opening of a bypass valve on a constant-speed motor-driven compressor, or speed reduction of an adjustable-speed centrifugal compressor.

Automatic Control Equipment Housings

Control-equipment housings and construction is of considerable importance because of its effect on convenience and economy. Most compressor-station control panels are conveniently classified as either "operator's control panels" or "auxiliary control panels." The operator's control panel is the nerve center, containing the automatic regulating and sequencing relays and devices, and operator's meters and control switches. The auxiliary control panels house the auxiliary motor starters, auxiliary power switches, and some protective devices.

MASTER STATION supervisory and digital telemetering panels. Fig. 13.

Fig. 9 shows a "duplex" type operator's control panel, with operator's switches, indicating lights, and indicating instruments on the front. Relays and other control devices are on the rear. This panel provides easy access through end doors to all wiring and connections within.

Fig. 10 is a common type of operator's control panel sometimes called a dual switchboard, with operator's devices on the front and relays on the rear doors. This panel offers a minimum of space requirements.

A desk or console, as shown in Fig. 11, offers a concentrated arrangement of pleasing appearance for the operator's devices. Interior access is not especially convenient, however, and a supplementary panel is often required to house the relays and other control circuitry components.

The usual type of auxiliary control panel is shown in Fig. 12. Accepted throughout industry, this type of panel provides long run reliability and convenience by concentrating the many auxiliary controls necessary to a compressor station.

Communication equipment is usually housed according to its location. Remote supervisory control and telemetering equipment is either combined with other controls on the operator's control panel, or may be in separate panels. Fig. 13 shows a supervisory control and telemetering panel which may be located next to an operator's panel. Generally any audio-tone transmitters and receivers used are located in the telemetering panel, but radio equipments (such as microwave) are located in a house next to the radio antenna.

Remote Control and Telemetering

Within the past 2 or 3 years an impressive number of gas-pipeline stations have been installed with equipment for remote control. Every major type of compressor and compressor drive is now being successfully remotely controlled. Although there are few (if any) published accountings of economic justification for these remote-controlled installations, a sporadic sampling of the industry has furnished the following:

1. New remote-controlled stations require less manpower than locally controlled stations. (Some stations do not have regular attendants at all.) Each additional man located at a new station might cost the company an amount equal to at least twice his salary, depending on increased housing requirements, added administrative expense, insurance, training, etc.

2. Since reliable communication channels are considered necessary in any case, one of the major costs of remote control may already be built in.

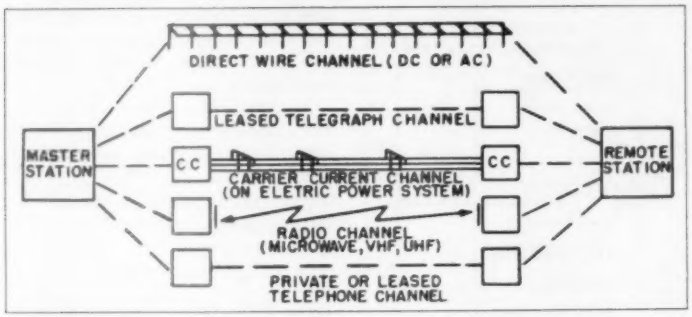
3. The cost of a reliable remote-control system to perform the basic functions for a station might be in the order of only $15,000 to $25,000, exclusive of communication channels. Maintenance of the remote-control equipment has not proved to be a major increased expense, especially in the cases where company-owned communication facilities mean maintenance personnel are already employed.

4. Verbal communications with the chief dispatcher are reduced and data handling and record keeping are speedier.

Oil and products pipelines have generally used remote control of stations more than gas lines. These oil pipeline stations are generally simpler to control, after using constant-speed pumps requiring only starting and stopping, with no adjustment. The gasline compressor station, usually much larger and more expensive, requires more complicated control and its compressors must continuously be adjusted.

The gas industry greatly fears even a short station down time, because of the immediate curtailment of con-

"The industry is making increased use of private microwave systems."



COMMUNICATION CHANNELS represented show wide variety in use. Fig. 14.

sumer service. However, cautious experimenting, proved equipment, and communication systems whose failure does not result in a station shutdown have brought more acceptance of remote control.

Practices and Trends

First, most users began by experimenting with one pipeline station being controlled from a nearby existing installation. Following the successful operation of this one station, others were tried.

Second, the first installations may have included a number of remote-control functions not believed to be absolutely necessary. However, the idea was to discover which were really useful and practical. As time allows, the number of remote-control functions and the quantity of telemetered data are expected to decrease, especially with added experience and more proven local automatic control systems.

Although oil-pipeline stations have followed this trend to the point of transmitting only "running" or "shutdown" indications for the master control station, it is not expected that remote control of gas-pipeline stations can be practical with this small amount of intelligence.

Third, there is a trend, and increased interest, toward the use of digital telemetering. Generally, digital data transmission is inherently more accurate than analog telemetering, and in many cases may require less communication channel space.

Fourth, digital data display and automatic digital data logging on preset log sheets are expected to gain in popularity. This eliminates errors in reading and logging, and reduces effort by the operators.

From a control and operating standpoint, the gas industry has advanced to a stage which might be termed the age of remote control. The trend to integrate groups of compressor stations and other equipment into one operating system is already established. The economics and technology of remote-control equipment occupies more and more of the pipeline engineers' time—so that it seems worth while for those associated with the industry to be versed in the principles.

Communication Channels

A major consideration in remote control and telemetering is the available communication channel. There are a wide variety of types in use, as indicated by Fig. 14, but the gas industry has generally used either leased telegraph, leased telephone, or private radio channels. The oil and gas-pipeline industry has indicated an availability of better than 95% for these channels in the past, and continued improvement is the trend.

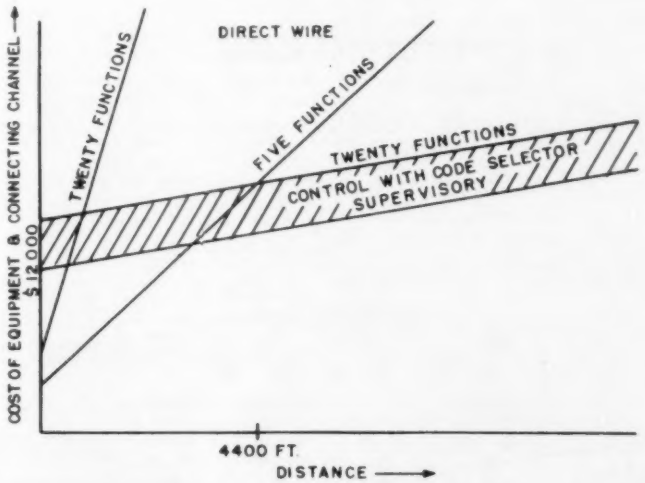
Telephone voice circuits, and private microwave radio channels permit transmission of frequencies in the audio range, so that any usual type of telemetering and supervisory equipment can be used. A typical microwave equipment might have 20-25 voice circuits on one common-carrier frequency, and depending on voice channel band width, each voice channel can carry a number of simultaneous audio tones for supervisory and telemetering signals.

Leased telephone voice circuits normally have a band width in the order of 300 to 3,000 c.p.s. These channels can also carry the usual supervisory or telemetering signals, and may carry a number of audio-tone frequencies for simultaneous use. Depending on the particular location and other factors, a voice channel may cost $3 per mile per month and up, but rental rates may also depend on the number of audio tones used.

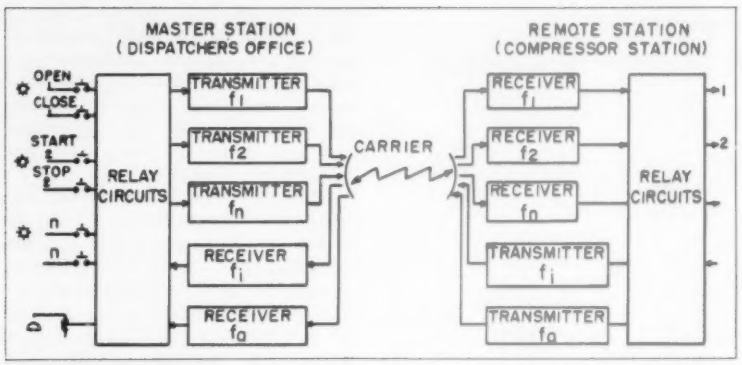
Except for frequency-type telemetering, most common telemetering and supervisory equipments have slow enough pulse rates so that simultaneous use of audio tones is possible when the tone frequencies are from 100 to 300 cycles apart. Thus audio tones have usually been the means of carrying these signals in order to conserve channel space.

Leased telegraph circuits are not capable of transmitting particular audio tones as such, and only accept pulses. These circuits are classified as to pulse rate (or keying speed), with the higher pulse rate circuits being more expensive. The usual pulse-code supervisory control and pulse-type telemetering can use the lower-speed (15 pulses per second) circuit, costing perhaps 75 cents per mile per month.

The industry is making increased use of private microwave systems. As greatly increased communications are



COST VS. DISTANCE is shown for remote control by direct wire compared with remote control by supervisory equipment in use today. Fig. 15.



SUPERVISORY SYSTEM uses individual tones or tone combinations. Fig. 16.

required these private systems are able to justify their cost. However, each case is different and no set rule can be made. In the isolated case for one set of data transmission, it would very likely be economical to rent a telephone voice or leased telegraph circuits.

Remote Supervisory Equipment

Of course, a number of functions could be remotely controlled by simply running a pair of wires for each function between the master and remote stations. However, one might be surprised to find that for distances over only a few hundred feet between stations, the proper installation of these wire pairs and the terminal equipment are more expensive than the standard forms of supervisory equipment available.

Fig. 15 shows the results of one study to compare remote control by direct wire with remote control by a supervisory equipment in use today.

The purpose of remote supervisory-control equipment is to furnish an economical means of performing a large number of operations over a small number of interconnecting communication channels. Supervisory control equipment can perform only two functions, that is, (1) energize or deenergize a remote relay, and (2) indicate whether the relay is energized or deenergized.

It is thus a two-state or binary end-result equipment, and does not remotely indicate quantity as does telemetering. The features of supervisory-control equipment which are desirable and available today are:

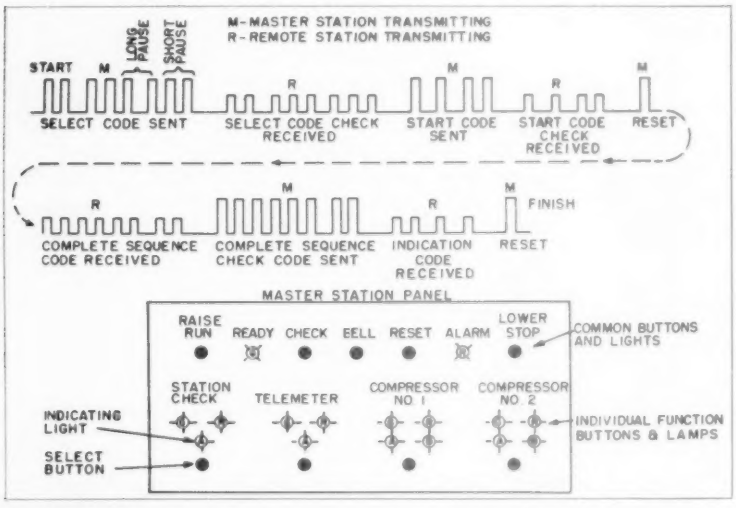
1. High reliability against false operation, usually accomplished by repetitive signals, or "check back" signals, and by signals of such distinctive characteristics as to practically eliminate chances of operation caused by sporadic disturbances.

2. High reliability with freedom from excessive maintenance.

3. Acceptable speed of operation. Two or three seconds for the completion of a supervisory-control function has been acceptable to the gas industry. Much higher speeds are possible with higher costs.

4. Ability to operate over a minimum number of communication channels, for minimum over-all system cost.

The two general types of supervisory-control equipments used by the gas industry may be classified as tone type and pulse-code type.



CODE PATTERN for remote compressor start with pulse-code supervisory. Fig. 17.

Tone Type Supervisory Control

Fig. 16 shows the schematic of a tone-type supervisory system. This is not a particular manufacture of equipment, but only a demonstration of a general type.

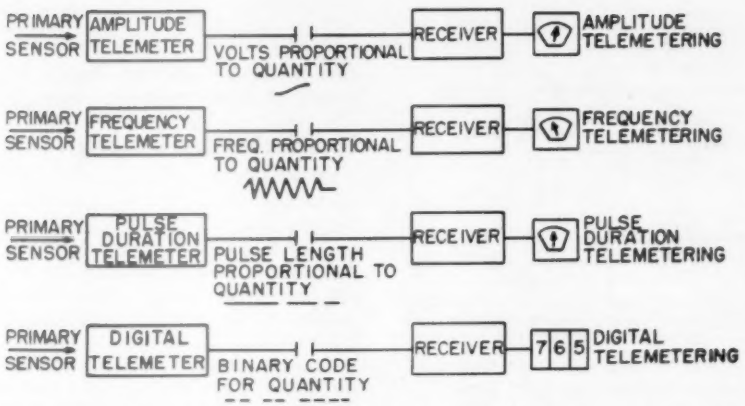
If the dispatcher wants to close a valve at the remote station he presses the (1) close button. Tone f1 (frequency No. 1) is transmitted over the carrier (radio, telephone, or telegraph channel) and is received by receiver f1 which receives only that frequency. This receiver activates a relay that causes the valve to close. In some systems this command signal might actually be a combination of tones, or short and long pulses of one tone, for safeguarding identification by the receiver.

Now in order for the dispatcher to know that the valve has actually received this command some signal must be sent back from the remote station. It is possible to use only one tone (frequency fi) for indicating the action of all functions if special relaying is employed at both stations. In case of a remote-station alarm, synchronized alarm-scanning devices in each station find the particular alarm condition and transmitter fa transmits a signal to energize the proper indicating light in the master station.

Pulse-Code Supervisory

Pulse-code supervisory-control equipment uses a series of pulses to transmit intelligence. Only two tones are required to handle the signals, regardless of the number of controlled functions. One tone carries the signals in one direction, and the other tone carries return signals.

The character of a pulse code can be established in many different ways. However, the best experience has been to use a code with a constant number of pulses, so that the receiving station knows if too few or too many pulses have been received. The character of the code is determined by the number and location of short and long pulses (or short and long pauses) in



TELEMETERING TYPES used by the gas industry are shown in diagram. Fig. 18.

the constant number of pulses transmitted.

Fig. 17 may be used to demonstrate how one type of pulse-code supervisory-control equipment operates. The master station's operating keys and indicating lights are shown on the rectangle; a sequence of code transmissions is demonstrated above. If the master-station operator wants to start compressor No. 1 he first observes the green "ready" light, which is energized when the supervisory equipment is not operating. Also he notes the green light is energized under (compressor No. 1), indicating it is shut down. Then:

1. The operator presses the compressor No. 1 select button, green "ready" light out, eight pulse "select code" transmitted.

2. Remote station transmits same code back (check-back), compressor green light out, compressor amber light on.

3. Operator presses "run" button, four pulse "start" code transmitted, compressor green light out.

4. Remote station transmits return check-back code.

5. Master station transmits single reset pulse, compressor blue light on.

Note: At this point the normal supervisory function is completed, but depending on the station equipment the compressor starting sequence may take several minutes. Therefore the standard equipment is arranged to notify the master station upon complete compressor starting sequence as follows:

6. Remote station transmits eight-pulse complete-sequence code. Master station returns code (check back).

7. Remote station transmits four-pulse code, compressor red light on.

8. Master station transmits single reset pulse.

This equipment inherently alarms when the status of a remotely controlled function changes. If some protective device shuts down compressor No. 1, for example, the remote station would initiate a series of codes resulting in an alarm bell and flashing red "alarm" light at the master station panel. Other noncontrolled alarm functions can be handled in the same manner.

The tone transmitter used at the remote station can also be used for digital or analog telemetering. In this event, when an alarm condition or normal command is initiated the telemetering will become inoperative until after the supervisory signals have been completed.

	HUNDREDS DIGIT	TENS DIGIT	UNITS DIGIT
EQUIVALENT DECIMAL NUMBERS →	8	5	2
TELEPRINTER (BAUDOT) 5 BIT CODE →	01100	00001	11001
CYCLIC BINARY 4 BIT CODE →	1100	0111	0011

TIME →

TYPICAL DIGITAL TELEMETER transmissions and decimal equivalent. Fig. 19.

Telemetering

Although supervisory-control equipment provides the master-station operator with a "yes-no" status of remote-station equipment, telemetering is needed to answer the quantitative question of "how much?" There are a number of different types of telemetering used by the gas industry, four of which are basically classified in Fig. 18 as amplitude, frequency, pulse-duration, and digital telemetering. The first three are further classified as analog because the signal transmitted is analogous or proportional to the measured quantity and not digital.

Amplitude telemetering is shown as transmitting a voltage (or current, etc.) of magnitude proportional to the pressure. Because of accuracy and interference problems this equipment is used only for short distances.

Frequency telemetering, an old but not too frequently used form of telemetering in the oil and gas-pipeline industry, transmits a signal of frequency proportional to the value being measured. This equipment is almost instantaneous in response, but the receiver has no memory and time "multiplexing" to save communication channel space is not practical.

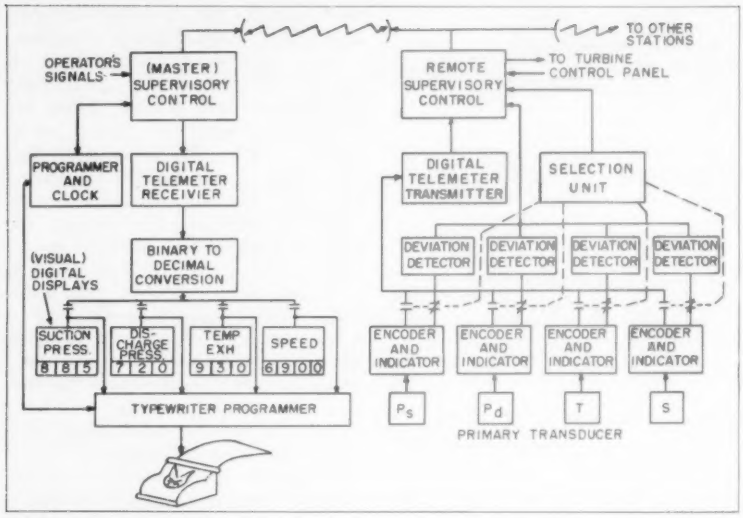
Probably the most familiar form of telemetering to the gas industry is that called pulse-duration telemetering. This equipment has a basic time cycle (such as 5 or 15 seconds). The cycle is divided into a portion during which a pulse is transmitted and a portion of no transmission. Either the length of pulse or the pause time is proportional to the measured variable, and the receiver measures to determine the proportional time.

A number of pulse-duration telemeters can be "multiplexed," so that each is transmitted in turn using the same tone. This equipment is reliable, but may be slower than desirable for some particular cases.

Digital Telemetering

Digital telemetering is expected to see increased use, having been proved in both the oil and gas industry. Its inherent advantages of high accuracy and simple communication channel requirements, as well as compatability with pulse-code supervisory equipment, should have increased appeal.

The principle of digital telemetering is as old as the many teletype systems in use for the gas industry, for it operates in a very similar functional manner. Where teletype signals are transmitted manually by an operator, modern digital telemetering systems include automatic sensing and transmitting of data, either on command by an operator or upon prescribed conditions.



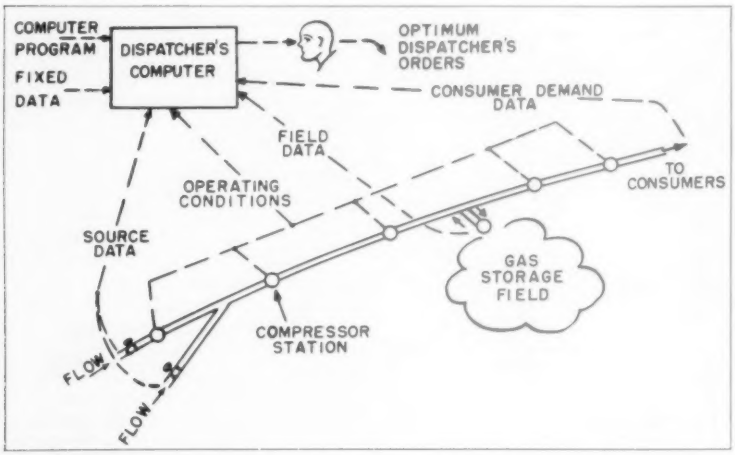
DIGITAL TELEMETERING system for remotely controlled station with one gas turbine. Fig. 20.

There are a multitude of codes usable for digital telemetering but the popular ones in use fall under the general classification of five-bit or four-bit codes. Remember that these codes are binary, or two-state, so that each of the four or five bits of information can be either of two conditions, pulse or space (energized or deenergized, etc.).

Refer to Fig. 19, showing a three-digit (852) transmission by the five-bit teleprinter code and also by the four-bit cyclic binary code. Let the "0" represent a pause and "1" represent an electrical pulse (or short pause and long pause, or short pulse and long pulse, etc.). In either case the bits of information are transmitted in time sequence, first for the hundreds digit, next for the tens digit, and last for the units digit.

Fig. 20 shows a block diagram of a digital telemetering system for a remotely controlled gas-turbine centrifugal-compressor station. This system uses similar relay or transistor circuitry for both the supervisory or telemetering functions. This particular example is arranged so that all telemetered quantities are transmitted in sequence, one after another, each time a "readout" is initiated.

A readout may be initiated at any time (1) by the master-station operator, (2) automatically at predetermined time intervals, (3) automatically upon an alarm condition, or (4) automatically when any measured variable deviates more than a preset amount since the last readout (say 5-psi. change in discharge pressure). Thus data are transmitted only when useful. The master station displays the data on digital indicators and/or automatically types it on log sheets.



COMPUTER is used as dispatching aid for optimum control of system flows. Fig. 21.

Optimization and Computers

Many operations in the gas industry have now been automatically controlled, and more tools of automation are rapidly being proved for use. Automation, a recent word for the old process of making things more automatic, is a popular expression. But care must be taken so that operations are not automated simply for the sake of automation. Improvements should be made for direct or indirect economic gain.

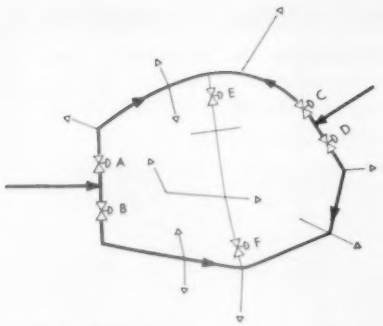
Automatic control of an operating function may well provide economic advantages, but further improvements may be possible. It is often easy enough to automatically control an operation, but is the operation being controlled for optimum results? Optimum control of an operation means control for the best long-run economy, whether automatically or manually.

Some methods of operation have been accepted for a long time in the gas industry, but they are not above question. The dispatcher may normally direct an old and relatively inefficient compressor station to hold maximum working discharge pressure, but is the pressure optimum? The answer to this might require considerable study, and involve a weighted composite of such things as safe line pack, minimum system fuel consumption, maximum flexibility for continuity of operation in emergencies, minimum human errors, maximum longevity of equipment, etc.

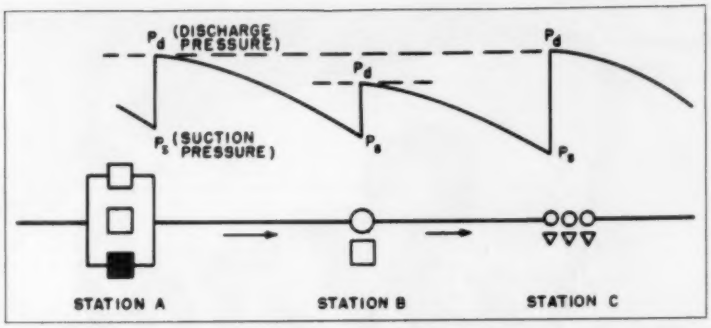
If an operating area can be controlled in a "more optimum" manner at present, the human operator may not be capable of making the necessary complicated calculations. In some cases, optimum control may require simple but more rapid calculation than is possible for a human operator. Therefore special tools may be required—possibly an automatic computer.

At the first mention of the word computer, it is well to note an important fundamental. A computer is of no use unless it is given a mathematical or logical problem to solve—it will do only what it is told in detail how to do. Therefore the conditions of some particular operation must be explicitly stated in mathematical terms or in completely detailed logical procedure before the computer can be used to solve for optimum operation.

As an example of the need for mathematics, consider the hypothetical gas pipeline with a large gas-stor-



GAS DISTRIBUTION system with two sources of gas. Fig. 22.



COMPRESSOR AND STATION operation for optimum economy. Fig. 23.

age field somewhere along the line. Refer to Fig. 21. The gas company knows that there is some particular manner of storing gas and using the stored gas for best over-all yearly economy.

However, a dispatcher cannot simply ask a computer verbally how to do this. All the conditions and constraints must be mathematically assembled and the computer programed for the solution. This gas-storage problem is just one of many in the gas industry where a computer might be useful.

Use of Computers

Computers may be classified in three major categories as to their use:

1. General-purpose computers for billing, accounting, engineering studies, etc. Many gas companies either own or rent these machines now. As an example, such a computer is often used for solving steady-state flow-pressure formulas and calculating necessary horsepower for handling expected flow increases in a system.

2. Special-purpose or general-purpose computers used as operating aids. The above-mentioned problems of gas-storage field flows might suggest a computer as an operating aid. The dispatcher could have a programed computer in his office so that as conditions change from day to day, he can use the machine to furnish data for optimum operation.

3. An "on-line" computer that automatically receives data and automatically furnishes control signals for optimum operation. This is truly an automatic-control device. Perhaps a reciprocating-engine station has a local computer that computes optimum compressor-pocket settings, engine speeds, which engines should be shut down or started, etc., and signals the engine controls to so operate.

Some outstanding examples of computer use for optimum control are appearing in other industries. Across the gas industry, too, there are investigations being conducted concerning the use of these newer and more sophisticated tools. The next 2 years should bring some interesting and advantageous results in this direction. The investigations won't all be simple and much effort will be required, but the rewards should be worth while.

Some of the operating areas which probably can be fruitfully investigated for optimum control are:

- Optimum division of flows on alternate routes, and optimum pressure regulation on distribution systems.
- Optimum pack and change of pack on main lines.
- Optimum loading of compressors in a station.
- Optimum division of load between stations on a line.
- Optimum division of flow between two main lines supplying the same area.
- Optimum quantities of gas from major source areas.
- Optimum quantities of gas from wells and treating plants within a particular source area.

Any of these operating areas afford a choice in manner of control, and when there is a choice there is an optimum answer.

The problem (represented by Fig. 21) of determining storage-field flows and line pack presents a wide variety of choice.

Consider the distribution system represented by Fig. 22. There are two sources of gas to this system, each of different B.t.u. content. How should valves A, B, C, and D regulate—hour by hour—to obtain the optimum amounts of gas from the two main sources?

As demand shifts from local area to local area throughout the distribution system during the day, how should the valves regulate to hold pressure necessary at all points? How should the valves regulate to accept steady contract amounts of gas from the pipeline during distribution load changes over the week end?

Fig. 23 demonstrates two of the possible areas where there may be choice and optimum control can be determined. Assume that stations A and C are multicompressor stations with good fuel economy. For less than maximum line flows, should the less-efficient station B operate at reduced discharge pressure (reduced load), and let station C boost the pressure back to "max working?" If so, what should station B discharge be? In the multicompressor stations how should the units divide load for optimum fuel economy and maintenance? According to horsepower, speed, or pressure ratio?

These types of problems are often not simple to document because they are affected by many considerations. Only careful investigation will reveal whether improved control is possible—before the machinery for control can be devised. Such investigations are generally not one-man operations, but require established management backing, clear understanding of what the investigation is about, careful consultation with all personnel involved to obtain their backing and approval, use of all available talent inside or outside of the gas company, and carefully prepared proposals and documentation.

Last, remember that the objectives of better control are to obtain economy and efficiency, not simply to use a computer or some other sophisticated device. These investigations have to be made on faith that effort will be rewarded, but even if they do not result in using a computer, better understanding and manual means of control should often result.

In summary, the gas industry has made considerable use of automatic control, and its use will increase. The improvements in economy and efficiency are becoming more complicated to define, however, and careful investigation is more important than ever. The gas industry has a challenge to use the new tools of automation, for they are available.

Mechanicsburg, Pa. terminal is one of 11 Sinclair distribution points serving markets along the new, large-diameter Laurel Pipe Line.

Battle Station in the War on Costs

No group has waged more vigorous battle against the rising cost of living than the oil industry. Witness that in 1959 the average price of gasoline, exclusive of tax, was less than 6 per cent higher than it was in 1949, while consumer prices generally rose 23 per cent over that period.

A key weapon in battling costs is efficient distribution. *The Sinclair organization continually improves—and is noted for—its ability to move products to market at minimum cost.* One of the most extensive pipeline systems connects six modern refineries with the most populous markets. Tankers and barges make large-volume deliveries. And 1,629 Sinclair bulk distribution stations—which can stock 720 million gallons—provide the flexibility of storage needed to serve economically a market where demand swings sharply with the weather.

Dealers and distributors trading under the dinosaur symbol of fine oil products know a dependable, low-cost distribution system sustains them in the market place. *In the battle against costs, Sinclair has powerful ammunition.*

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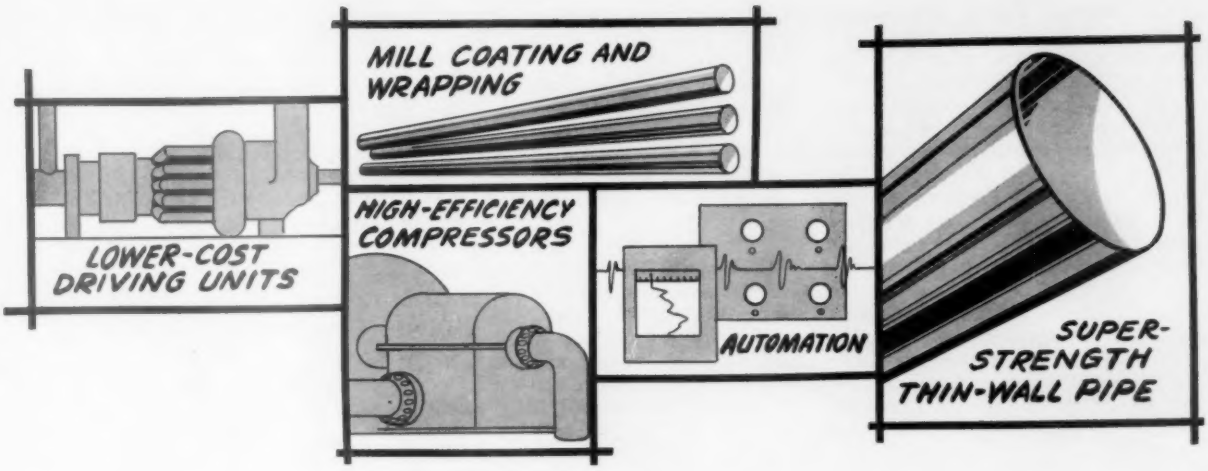


What's being done to give you

More capacity for your pipeline dollar

• A Journal survey of transmission companies and pipe and compressor-machinery manufacturers reflects concern that inflation may threaten future expansion. Their replies show what's being done to offset rising costs and what pipelines would like to have that is not now available.

BY GENE KINNEY
Assistant Pipeline Editor

"I CAN WEAR myself out working to automate my system, increase efficiency, and reduce labor costs and fuel consumption without making a noticeable dent in the cost of service. But let me find a way to cut capital costs of pipe or major machinery—then I've got something."

This comment of a pipeline executive points up the approach of the gas-transmission industry to the problem of inflation. Technical advances adopted in the past 5 years have done much to offset rising costs. Innovations recently introduced offer further benefits, and the near future seems to hold still more opportunities. The goal: either to reduce unit transportation costs or at least to avoid sharp increases.

Here's what's being done:

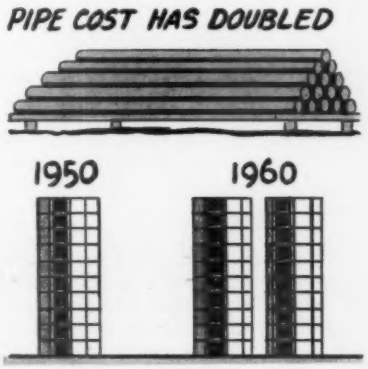
By pipe manufacturers — higher-strength pipe is coming this year, at least from one manufacturer.

By equipment manufacturers—new designs of gas turbines driving centrifugal compressors with much lower first cost are being installed, and standard compressor units have increased power, efficiency, and automation.

By transmission firms — new high-strength, thin-wall pipe is being used; construction methods which cut costs are being adopted; widespread experiments with new compressor machinery are under way; new station and building designs are cutting investment and operating costs.

The Problem

The general picture is one of positive action to combat inflation trends which quickly offset in part or cancel the steady progress of recent years.



Emphasis is toward more capacity per ton of steel. Why is this so?

Pipe in the ground represents from 70 to 90% of the capital investment in a pipeline system. The pipe itself, the principal cost item, has doubled in price during the past 10 years. Other costs have risen, too, although not so rapidly.

The experience of the Columbia Gas System, Inc., is a good example of what the industry faces. Since 1947 Columbia has invested $560 million in new facilities. At 1947 prices, the company estimates the cost of those facilities would have been $350 million. At the same time natural gas, which must compete with fuel oil and coal in most markets, has increased in price. In 1951, Columbia paid to pipeline transporters an average of 23 cents an M.c.f. In 1958, it paid an average of 36 cents. Columbia's gas purchases in 1958 amounted to $204 million, some $52 million more than the same volume would have cost at 1951 prices.

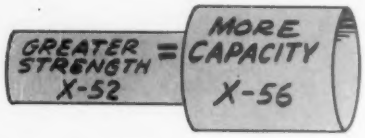
In order to expand, transmission companies must be able to sell gas in competition with other fuels, as well as each other. They are therefore vitally interested in attaining the lowest possible unit transportation costs. If progress in this direction is not made, what will happen? This question, put to companies in the survey, generally brought the following answer: "We will soon price ourselves out of some markets."

They feel they can do little or nothing about wellhead gas prices, which have risen from abnormally low levels. Numerous operating-cost items are so small in the total picture as to offer no major incentive for progress. Hence the preoccupation with capital costs.

High-Strength, Thin-Wall Pipe

The survey discloses increasing acceptance of the new high-strength pipe, having a yield strength of 56,000 psi., introduced 2 years ago. And a steel company said it would announce within 3 weeks a line pipe of even higher yield but still readily weldable.

X-56 acceptance. Columbia Gulf Transmission Co. has been a pioneer in using X-56 pipe on a large scale. In 1958 the company installed 351 miles of 30-in. by 0.375-in.-wall X-56 pipe as main-line loops. (The original line built in 1953 is 30-in. by 0.375-in.-wall 5LX-52,000 psi. yield with an allowable operating pressure of 935 psig.) The X-56 loops, when completed into a second main line, will allow an operating pressure of 1,008 psig.



By using higher-yield pipe materials, Columbia Gulf will deliver through its X-56 second main line 625 million cubic feet a day compared to 575 million for the X-52 pipeline. It will thus reduce the cost per million cubic feet of gas transported, even after paying the premium for higher-strength pipe.

Transwestern Pipeline Co., designed by Gulf Interstate Co., an engineering company spun off from Columbia Gulf's predecessor, will have X-56 pipe throughout its Texas-California trunk line. The purpose is the same: to attain increased throughput from higher pressures.

Colorado Interstate Gas Co. this year plans for the first time to go to pipe with a yield strength above 52,000 psi., which has become standard for large-diameter trunk lines. CIG's program includes 30 and 34-in. pipe in a new line from the Texas Panhandle through Colorado, Wyoming, and part of Utah to deliver gas to El Paso Natural Gas Co. "We will use X-56 grade line pipe at a substantial reduction in total cost," CIG reported.

What next? The consensus of steel companies is that the next advance in pipe will be the introduction of grades with 60,000 psi. yield. Possibly this will be out only a brief time before a 65,000-psi. pipe will be announced. There is some indication that increases will not necessarily be stepwise but may jump sharply if steel of good properties is developed.

The dilemma is this: Line-pipe yield strengths can be raised to almost any reasonable level by the use of alloys. However, alloys are expensive in relation to properties achieved compared with conventional carbon steels used for API-5LX pipe.

Most companies consider this to be the most promising area to influence the costs of delivering gas. Columbia Gulf predicts: "Within the next few years, 80,000 to 90,000-psi. yield pipe material with good weldability and notch-toughness characteristics will be available and in service on many pipelines."

Large diameters. Economic studies show that a company should lay the largest diameter, thinnest wall possible. The present ceiling on diameter is 36-in., although some mills, if they received a sizable order, could make 40 or 42-in.

None of the pipelines expressed plans to use diameters larger than 36-in.; two had studied projects with 42-in. Most do not have the volume to justify 36-in. on an initial project; some companies have just begun to install 30-in., and others this year will use 34 and 36-in. for the first time.

Here is one prediction: Diameters larger than 36-in. are unlikely in the foreseeable future except for use possibly in congested areas where the cost of pipe is relatively small in relation to the total cost of laying pipelines in such areas. The need for larger-diameter pipe is questionable inasmuch as increased strength in the present sizes will permit the transmission of more gas and will be economically more attractive.

Thin walls. Almost all companies mentioned the trend to thinner walls, made possible by effective corrosion protection from improved coatings and widespread use of cathodic protection.

However, "extra steel" is still part of the design picture, as pipelines move toward the goal of the thinnest wall possible under the piping codes. Company policies vary widely here. But the trend is in the direction of less wall thickness, in trunk and gathering pipe. As an example in small pipe, Colorado Interstate has reduced minimum wall thickness to 0.125-in. for gathering-line pipe and fittings; small lines are mill coated and wrapped.

Materials Other Than Steel

Columbia Gulf recently completed a 6-in. aluminum pipeline, a 1-mile test section of aluminum alloy uni-strength pipe with 0.272-in. wall thickness and 1,000 psig. operating pressure. The purpose is to determine actual construction and operating costs compared with steel, and to check flow efficiencies. The obvious goal is to find a competitor for steel to bring about price competition.

Columbia Gulf also is evaluating a large-diameter flexible-hose river crossing. It believes flexible hose will offer a method for reducing the high costs of major aerial or underground pipeline river crossings, giving equal or greater service life than present methods.

"The obvious goal is to find a competitor for steel to bring about price competition."

Natural Gas Pipeline Co. of America and others have tested plastic pipe for low-pressure gathering systems. And a new plastic with working pressure above 150 psi. is expected to be announced this year.

Installation Methods

The most revolutionary change in construction that has been expected "momentarily" for some time is automatic welding on the right-of-way. A machine has been built and should be

GAS TRANSMISSION COMPANY SAVES $535,000 with HIGH YIELD CAL-METAL PIPE

112.5 MILE 16" PIPELINE IS LONGEST LIGHTWALL LINE EVER LAID

By choosing Cal-Metal Hi-Yield pipe for the job, this southeastern gas transmission company saved over half a million dollars on the 112.5 miles of line.

Cal-Metal Hi-Yield lightwall pipe furnished on this project was 16" O.D. x .219" wall, grade X-42 tested to 1,000 psi. An alternate wall thickness considered was 16" O.D. x .281" wall, grade B tested to 750 psi.

Cal-Metal Hi-Yield lightwall pipe permitted faster field handling, easier line-up and shorter welding time. Cal-Metal's 55 foot lengths reduced the number of field welds. The bendability of Cal-Metal Hi-Yield pipe provided further savings in the rolling hills along the right-of-way.

The saving using Cal-Metal Hi-Yield lightwall pipe over the heavier pipe was in excess of $535,000.

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demonstrated this year. The word is that this may at last be "it."

One company has reduced specifications to 1 ft. of cover in solid rock, thereby cutting ditching costs. Another has dropped the use of glass-fiber wrap on the basis of 25 years' experience. Several cradle pipe directly into the ditch after wrapping.

A pronounced increase in yard coating of pipe as an economy measure was noted. With the advent of internal coating to maintain new pipe efficiency, there has been a trend to apply the external coating at the same time. A large number of pipelines have gone to internal coating in the past year while others are "awaiting further proof of its benefits."

Double jointing at the mill and at rail heads is becoming more common.

In marsh and marine areas, cost-cutting methods have been the use of screw-type anchors, draglines on marsh buggies, helicopter surveys, longer single joints (up to 52 ft.), and decreased weighting of pipelines.

Compressor Machinery

New and improved designs. Most of the excitement is in new gas-turbine centrifugal - compressor units, which promise to cut first costs by one-third to one-half, and in automation. But most of the money is being spent on modernization—on improving existing equipment — and installing modified designs of conventional equipment.

Modernizing of compressor machinery has been a continual process in the past 5 years, and that is the picture for the future, too. Pipelines are still turbocharging existing equipment to obtain cheaper incremental power and installing turbocharged units in new stations.

The development of a two-cycle, turbocharged angle compressor engine has increased compressor output by as much as 40% over the corresponding simple scavenged two-cycle angle compressor unit. By eliminating altitude deration up to 7,500 ft., with turbocharged equipment, Colorado Interstate estimates it will gain an average increase in power of about 10% per dollar spent in 1960.

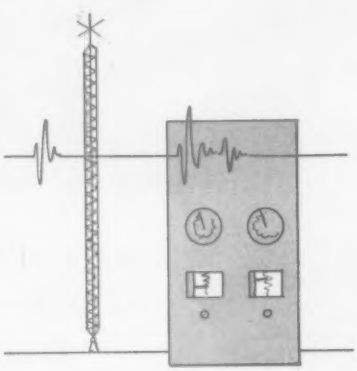
Most pipelines are going to unitized engines to eliminate costly auxiliary and generating equipment, to reduce piping, to reduce building size, and to eliminate basements. Some are attaching auxiliary buildings to main buildings. Shed-type building construction is being borrowed from oil pipelining and may become a common cost-cutting method.

A full vapor-phase system in which steam generated in the jacket water is used to drive the fan for dry air coolers has been applied economically.

New high-pressure gas-piping systems are installed to conform to analog computer designs to suppress pulsation.

Automation. Automatic control, both local and remote, is fast becoming a major means of more effective and efficient use of existing horsepower while reducing operating costs.

The Transwestern and Colorado Interstate systems installed this year will incorporate remote control. Several



"Automatic control . . . is fast becoming a major means of more effective and efficient use of existing horsepower while reducing operating costs."

companies have installed one or more remote-controlled stations, and others revealed plans for this year. Columbia Gulf, a pioneer in automation with its engine-driven centrifugal station in 1955, is automating its entire system, including the original reciprocating stations (designed first for one-man operation) as well as the new centrifugals. But local push-button stations are the standard at this point. Even old horizontal units are being equipped for automatic sequence control.

More horsepower per dollar is obtained by installing motorized compressor-cylinder pocket operators and motorized engine - governor operators actuated by controllers in station control panels. Greater efficiency is realized from existing horsepower by having integrated pocket and speed control accomplished automatically to preset suction and discharge conditions.

Large single-unit stations of all types (which are easily controlled) are becoming popular as a means of reducing unit costs sharply for peaking service or on high-load-factor lines.

Gas turbines. The glamor drive of the industry at this moment is the gas turbine. When asked to cite the best hope for reducing station costs, pipelines mentioned the gas turbine more often than anything else. (There was generally the reservation that the work horse of the industry would remain the two-cycle angle compressor unit with its high efficiency and flexibility.)

Wide attention is focused on Columbia Gulf's experiment with a 10,500-hp. modified J-57 aircraft-type jet engine and a reaction turbine driv-

"Jet engines for gas transmission . . . a major breakthrough in obtaining low-cost horsepower."

ing a centrifugal compressor. The unit is being installed to operate automatically and unattended. The company estimates the cost at $190 per installed horsepower compared with $365 which it cites for engine-driven centrifugals and which is comparable reciprocating stations. Columbia Gulf describes the use of lightweight aircraft-type jet engines for gas trans-

"Technical advances in the past 5 years have done much to offset rising costs."

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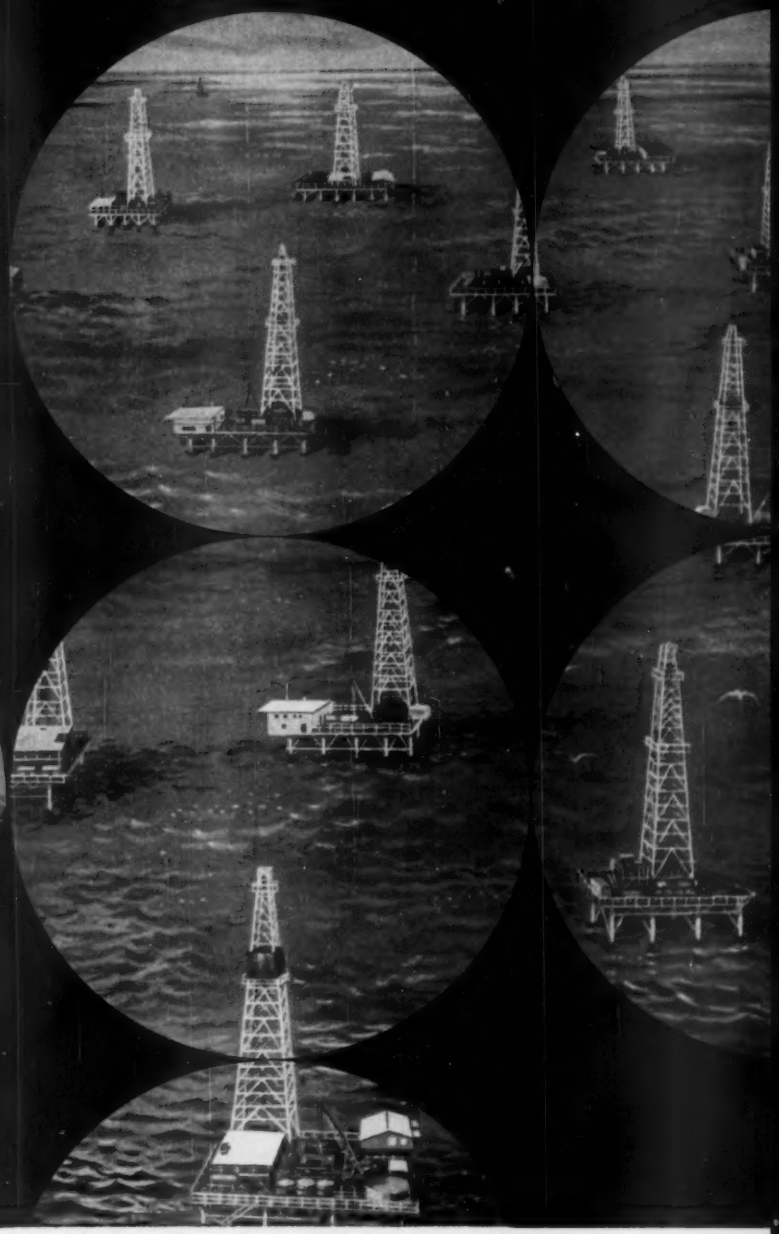

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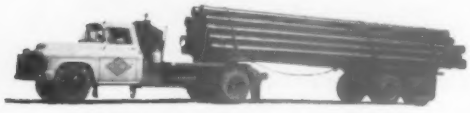

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mission as a major breakthrough in obtaining low-cost horsepower.

(Texas Eastern Transmission Corp. has already obtained a cost under $200 per horsepower with its 13,500-hp. single-unit gas turbine stations, and about $120 per horsepower with 15,000-hp. single-unit electric stations.)

Trunkline Gas Co. is conducting another significant experiment with lightweight gas turbines. It is obtaining an installation cost under $200 per horsepower and with small units (1,000-hp. range) capable of great flexibility. These units operate in the 20,000-r.p.m. range directly driving a centrifugal compressor. A manufacturer of one of these units estimates that the complete gas-turbine compressor package can be marketed for $80 to $100 per horsepower in the future.

The gas turbine as a centrifugal-compressor driver has been improved rapidly, and further improvement is expected. Progress will come both in larger units to reduce unit costs and in smaller units, which also will have low unit costs and will fit applications which rule out large sizes.

Engine centrifugals. The development of large (3,500-hp.) four-cycle engines to drive centrifugal compressors has provided installation and operating economy for five pipelines.

These units have been automated successfully. They have simplified main gas piping and reduced concrete foundation and building requirements.

Columbia Gulf is installing a new 4,000-hp. two-cycle engine driving a centrifugal compressor, due to start up this month. The purpose is to determine the economics and feasibility of using two-cycle engines for driving centrifugal compressors through step-up gears.

One pipeline not now using engine-driven centrifugals said it plans to use larger engines as single units for driving both reciprocating and centrifugal compressors.

The transmission companies made one point repeatedly in different ways. That is that the purpose of much experimentation has been to establish price competition as well as to reap the benefits of new equipment which does prove out.

What Pipelines Are Demanding

In pipe and installation. There was remarkable unanimity among pipelines as to what they wanted in the future from manufacturers and constructors. Here are the items mentioned most often:

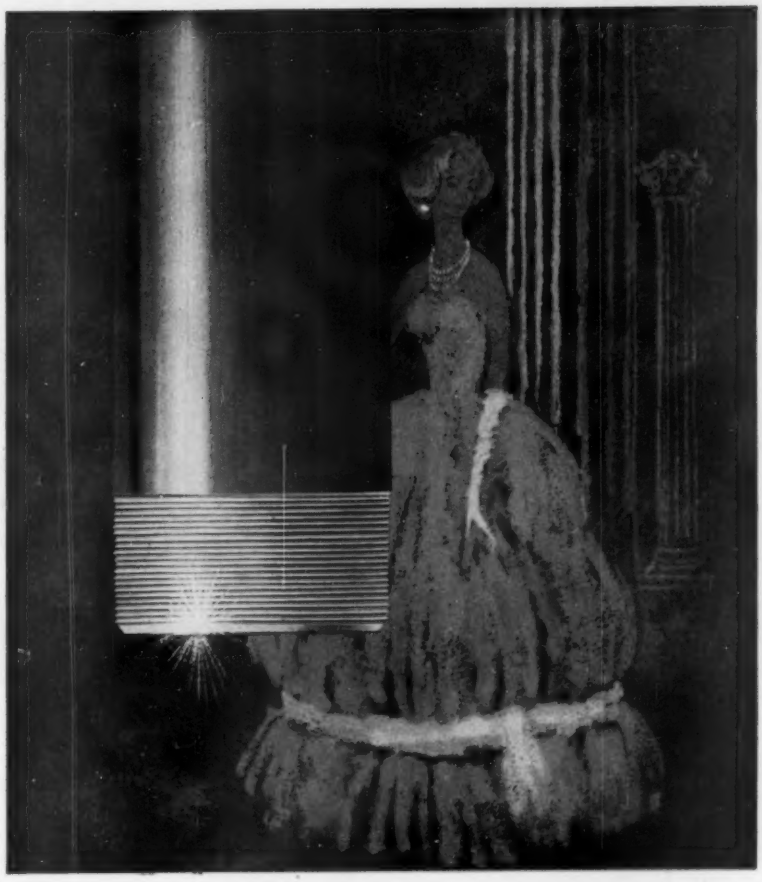
• Mill-coated pipe, internally and externally. (There were demands sim-

ply for "better coatings and better application methods"; some asked specifically for mill coating with epoxy resins; virtually all looked upon mill coating as inevitable and wanted it pushed to eliminate over-the-ditch coating as a means of obtaining a more nearly perfect insulator at lower cost.)

- Higher-strength, thinner-wall pipe at "reasonable" premiums. (One asked specifically for a 90,000-psi. yield pipe; there were requests for "readily weldable higher-strength pipe with acceptable transition temperatures," "better manufacturing techniques and better control of materials to develop higher tensile strength," "improved pipe-manufacturing methods and specifications at the same cost," and "a lower percentage of faulty line pipe.")
- Pipe manufactured from nonferrous materials at a competitive cost.
- Automatic welding for the right-of-way.
- Line travel shot or sandblast pipe-cleaning machine.

In compressor machinery. More often than anything else, pipelines asked for "more efficient equipment at less cost." They asked specifically for:

- Lower fuel consumption.
- Smaller engines.
- Larger engines.
- Gas turbine and centrifugal compressors in the 500-1,000-hp. range.
- Small gas-turbine centrifugals for individual well locations and for points of field-gathering locations.
- Compressor units designed for reduced noise level for urban sites.
- Cheaper coolers—not materially affected by atmospheric conditions.
- Engines designed specifically for vapor-phase cooling, with jackets on the engine cylinders designed to provide flow of both the water and the steam at a greater rate and thus provide better cooling with resulting reduced maintenance and longer life.
- Improved compressor-cylinder design to minimize pulsation dampeners.
- Large air-cooled engines.
- Ceramic-coated wear surfaces and synthetic lubricants to eliminate or greatly reduce engine and compressor lubrication and wear problems.
- Compressor units with added detection devices built into the equipment for full remote and automatic operation including measurement of fuel and oil consumption.
- A well-engineered, integrated control and monitoring device for automation as normal equipment rather than as special equipment. (This would also apply to automatic start-stop sequence equipment.)



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THIS MOUNTAIN AREA exemplifies rough terrain laid with 80-ft. joints, in accordance with the H. C. Price Co. practice in building across Arizona.

1960's biggest pipeline uses X-56 pipe for entire main line

Winter construction with high-tensile pipe requires preheating for welding and defrosting before coating. Eighty-foot joints are used for first time in mountainous terrain. Firing-line innovation used.

THIS REPORT BY PAUL REED, the Journal's much-traveled pipeline editor, tells what he found on a trip to the five spreads on Transwestern's 30-in. main line across Arizona and New Mexico. Reed is shown entering a helicopter on Price's western spread.

FOR THE FIRST TIME certain advanced practices coming into pipelining are being applied on an unusually large scale in the building of the Transwestern Pipeline Co. system.

Particular attention has been given to the extensive use of the high-yield X-56 pipe introduced into the industry in the last 2 years. In the first 2 months of Transwestern construction, experience showed that methods for welding and bending are the same for X-56 as for X-52 pipe. But more precautions are needed in these operations.

Of much significance for future trends is the successful use of the long 80-ft. joints in rough mountainous country in the Arizona section of the line. The shorter 60 and 40-ft. joints are being laid simultaneously in the New Mexico section of the main line.

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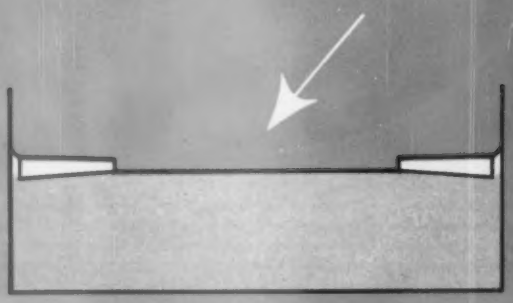
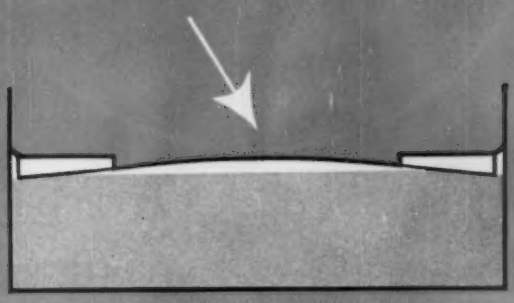


The Horton Pontoon Floating Roof has an annular pontoon around the outer edge of the roof and a deck of single thickness at the center. The pontoon provides effective air space insulation for a large area of the liquid surface. Under normal conditions, the underside of the Horton Pontoon Floating Roof is in contact with the product in the tank.



Increased temperatures may cause the product in the tank to boil. Should this occur, the vapors are trapped beneath the center section of the roof due to the upward slope of the pontoon bottom and the flexibility of the center deck. The trapped vapors lift the center of the deck and provide an insulating vapor space to reduce further boiling.

130,000-bbl. tank equipped with a Horton Pontoon Floating Roof serves the marine loading terminal of a West Coast oil company.

Prime reason for equipping flat-bottom storage tanks with floating roofs is to prevent the loss of valuable volatiles through evaporation. Efficient vapor trapping is essential for the more volatile stocks.

The sun's rays striking the single deck portion of a floating roof heats the deck and the product beneath. Boiling often occurs, causing vaporization. Unless these vapors are retained by the deck rising from the product, boiling will continue. Horton Pontoon Floating Roofs trap these vapors. They form an insulating space during the heat of the day retarding further boiling. As cooler temperatures occur, the vapors recondense and the deck returns to the liquid surface. The result: *Maximum protection against costly evaporation loss and deterioration of product.*

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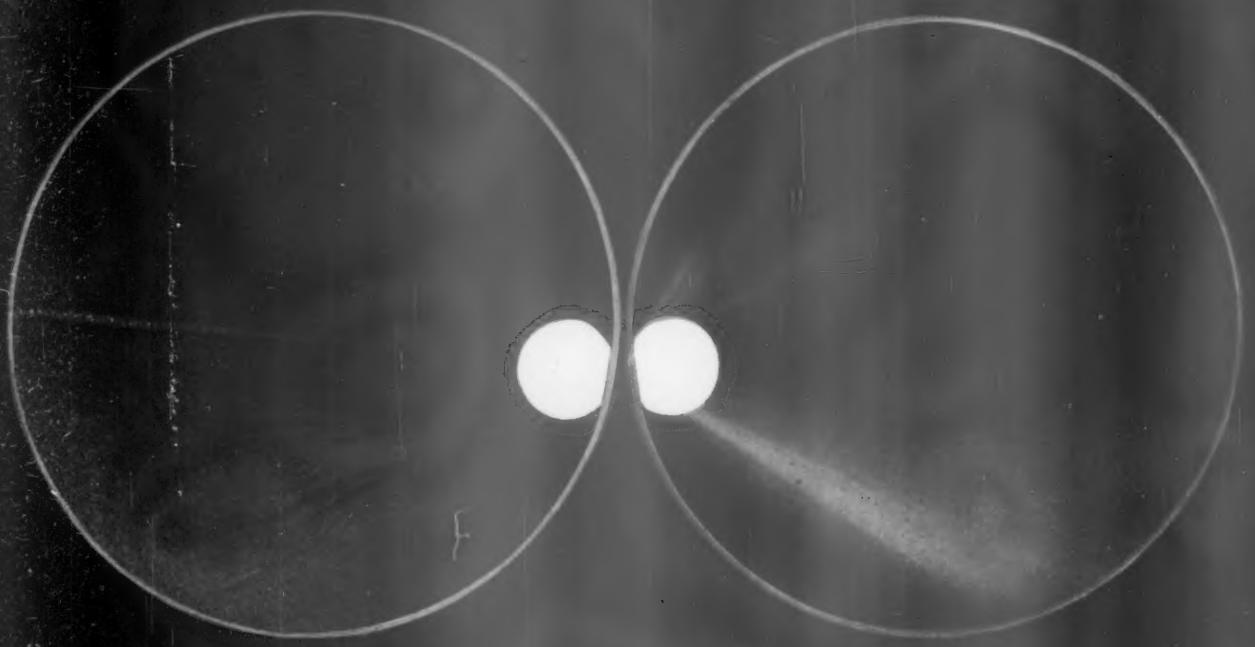

The uncoated mill pipe pictured above, left, was the last section in a 225,000 ft. string of 30" line pipe internally coated by L. C. Russell for Transco at the Steelton yards of Bethlehem Steel Mills. At the right Napko's Epoxycote Pipeliner, the first amine-cured epoxy resin specifically formulated for gas line transmission, imparts to the finished section a surface smoothness that will increase line-flow efficiency and reduce maintenance costs.

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Extra Thru-Put and Cleaner Gas at Lower Maintenance Cost

Throughout the United States pipeline engineers report that lines internally coated with Napko's Epoxycote Pipeliner show record improvement in thru-put, product purity, and line maintenance economy.

Studies indicate that the walls of coated pipe have an average relative roughness of 280 micro-inches, compared to an average of 700 micro-inches in unweathered mill pipe. Weathered pipe in a mild environment in as little as 60 days can attain a surface roughness up to 1500 micro-inches (an additional 2-5% loss in efficiency).

Leading internal coating specialists such as L. C. Russell Company, Rosson Richards Company and H. C. Price Company testify to the dependable behavior of Epoxycote in both application and finished film properties.

For complete details and published project references write to

TESTED FEATURES OF EPOXYCOTE PIPELINER

PREVENTS PITTING IN TRANSIT & STORAGE: In industrial atmospheres, humid regions, and particularly marine areas, severe pitting can occur in uncoated pipe. Epoxycote moisture and chemical resistance virtually puts an end to pitting.

REDUCED CLEAN-UP EXPENSE: Pigging a new line to remove loose rust and millscale can cost up to 17¢ a foot, but after cleaning and lining with Epoxycote, a single plug is usually sufficient. Napko Epoxycote has maximum hardness to help prevent pigging damage.

CLEANER LINES & GAS: All rust and loose millscale can not be removed from uncoated pipe by pigging. Prior lining with Epoxycote minimizes load on scrubbers, with the cleaner gas ultimately reducing service of consumer gas appliances by the gas distributing company.

INCREASED CAPACITY: Friction losses are reduced by smoother internal surface.

PREVENTS INTERNAL CORROSION: Minute traces of moisture, oxygen, and such contaminants as hydrogen sulfide, accelerate pitting of uncoated pipe. Epoxycote Pipeliner is chemically resistant to the corrosive impurities of natural gas, insuring maximum protection of the line and the product.

NAPKO CORPORATION

INDUSTRIAL COATINGS DIVISION

P. O. BOX 14126 • HOUSTON 21, TEXAS

Notable innovations have appeared in the organization of welding equipment and methods.

Furthermore, this is the first time when five big-inch spreads have battled their way through winter months in a mountainous area where Arctic and Alpine conditions have widely prevailed with heavy snow and much subzero weather. There have been problems in getting deep snow out of long stretches of ditch, and a variety of provisions for preheating before welding and defrosting before priming.

Even in some of the worst going, late in January, construction progressed ahead of schedule and was well in the clear toward meeting the scheduled completion date in July 1960.

This article presents information obtained in a 10-day trip from an area near the California-Arizona boundary to Roswell, N. M., to visit all of the five spreads laying the 645-mile, 30-in. Topock, Ariz.,-Roswell, N. M., line. Operations will be discussed in the order in which the spreads were visited.

Lowest elevation is 600 ft. at the western end, and the highest about 8,600 ft. in the vicinity of Flagstaff, Ariz.

This section is the largest diameter segment of the total 1,172 miles of main line being built to transmit gas from gathering systems in Oklahoma, Texas, and New Mexico. Design, construction engineering, and supervision are being handled for Transwestern by Gulf Interstate Co. H. C. Price Co. and Houston Contracting Co. contracted pipeline construction of the project and subcontracted parts of it to other contractors.

H. C. Price Co.

Large-scale operations are demonstrating that it is practicable to lay 80-ft. joints of big-inch pipe in extensive stretches of rough country. In this demonstration, H. C. Price Co. on the Transwestern project, brings an answer to a long-standing question in the industry. Success with these long double joints of 30-in. pipe became clear during the first few weeks of laying through rough mountainous country by two Price spreads in eastern and western Arizona.

Three features of Price's operations on Transwestern, (1) double jointing by automatic welding, (2) use of 80-ft. joints throughout a long job of much roughness, and (3) the latest revolutionary innovation of Price—concentration of welding machines in three tractor-driven units on the firing line—all contribute to the long-range Price program for facilitating the forward flow of pipeline construction.

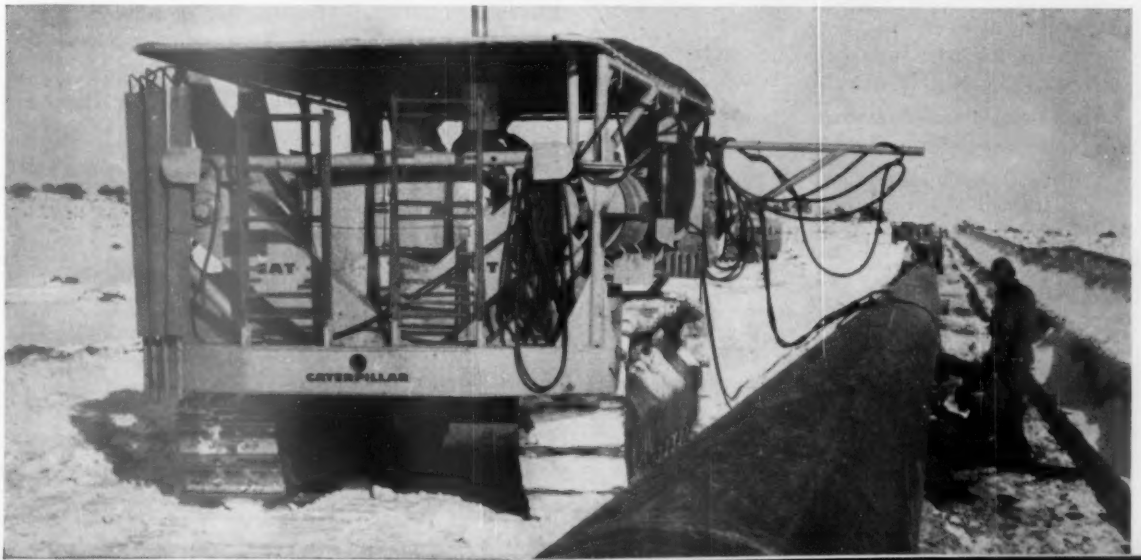
"Pipelines are built by movement," said Harold C. Price, Sr. "Everything must move. You must move, move, move." The double joints and the concentration of 12 welding machines on three tractor-mounted-and-driven units minimize the number of points where equipment stops to serve welding. Advantages of easier forward movement are considered to be worth what they cost.

Leading up to what he is demonstrating on the Transwestern project, Price developed special automatic-welding procedure and equipment for double jointing some of the 1957 Trans-Canada work in Manitoba. Advantages of 80-ft. joints paid off in flat country. The next year their possibilities were tested in a limited way in some rough country on Trans-Canada near Toronto.

Handling long joints. Even in the roughest spots on Transwestern, Price did not find it necessary to mix 40-ft. joints with 80-ft. joints in order to get more flexibility. While the rough

CONVENTIONAL • Firing-line welding units with special shields for windy weather in Houston's spread near Roswell, N. M.

INNOVATION • Each of three identical tractor units carries four 300-amp. welding machines driven by the tractor engine. These are serving firing-line welders on Price's eastern spread in the Window Rock, Ariz., area.



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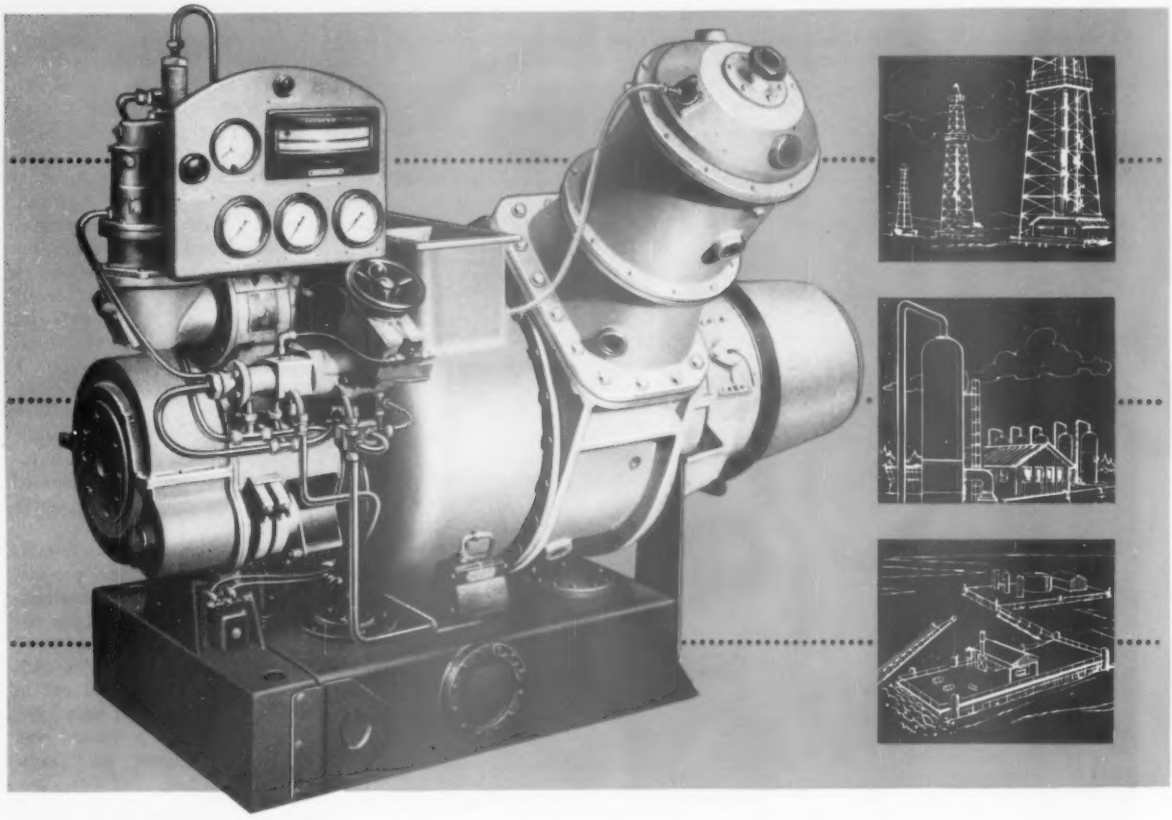

This engine will change forever your concept of gas turbine power. That's because it's engineered from the ground up for heavy-duty service . . . designed to bring you all the benefits of gas turbine operation in a package rugged enough to meet the demands of industrial applications.

Compared to aircraft-type gas turbines you've seen before, the Model "TE" offers these important advantages:

LOWEST COST PER HORSEPOWER—Lowest first cost, lowest maintenance costs.

LONGEST LIFE—The only turbine in its horsepower range designed and built for 50,000 hours service life.

SIMPLE DESIGN—Open-cycle type with single-stage centrifugal compressor and single-shaft rotor.

RUGGED CONSTRUCTION—Engineered with low component stresses for heavy-duty service.

EASIEST TO MAINTAIN—Built to deliver a minimum of 5,000 hours between overhauls, with all components easily accessible for routine maintenance.

Complete specifications and performance data on this rugged new industrial gas turbine are yours for the asking. Write on your company letterhead for the Thompson-Ruston Model "TE" catalog.

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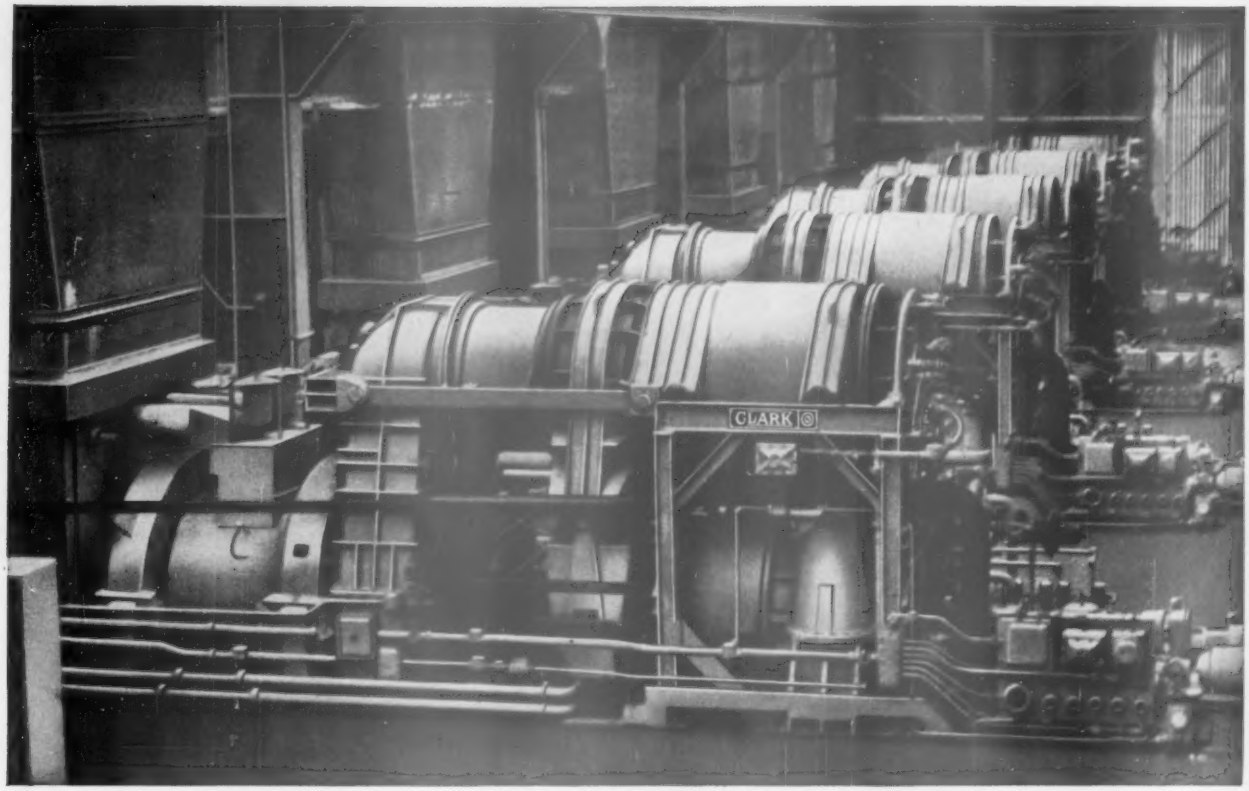
PIPE GANG of R. H. Fulton & Co. near Grants, N. M. In foreground are four strip welders and four hot-pass welders. Stringer beads are run by three welders. Two boom tractors in the distance are setting in 40-ft. joints for lining up.

mountain terrain in Arizona had not been as rough as that in West Virginia—the roughest for pipelining—there has been more extended roughness on this Transwestern job.

Contrary to expectations of many pipeliners, the 80-ft. joints proved to have several important advantages in rough country. Bending on the slopes was done faster because of the smaller number of joints moved to and from the bending machine. On 80-ft. joints as many as three slight bends could be made, while on 40-ft. joints only two such bends would be practicable. There was less cutting and fitting with pup joints. Altogether the 80-ft. joints have advantages for bending in rough country as well as in flat country. Likewise, pipe gangs moved faster up the slopes and particularly over the crests of ridges, because with 80-ft. joints only half as many joints had to be welded.

Status of long joints. It would be misleading to compare the output of spreads using 80-ft. joints with those of spreads using 60 and 40-ft. joints during the first 2 months of pipelaying on Transwestern. Terrain and

AUTOMATIC welding-plant operations are shown in these three views. Below, Cross Price-O-Matic automatic submerged-arc unit double-jointing 30-in. pipe at Seligman, Ariz. Below, right, operator is about to enter 30-in. pipe on gantry boom to run the inside bead after the two outside beads have been run. Right, special side boom cuts costs of carrying two 40-ft. joints at a time from stockpile to automatic welder.



Five Clark Model 305 Gas Turbines drive Clark vertically-split centrifugal compressors operating in series. The station is highly automated with only two operators required per shift.

CLARK Gas 210,000,000

In the Arabian Desert...

At 'Ain Dar, Saudi Arabia, five Clark Model 305 Gas Turbines are driving Clark Vertically-Split Centrifugal Compressors for the gas injection program of the Arabian American Oil Company.

Surrounded on all sides by the torrid Arabian desert, the turbines and compressors are installed in a pressurized building to keep out wind driven sand. Available fuel for the turbines is sour gas while ambient temperatures soar to unusually high levels.

The 'Ain Dar injection plant draws gas from five gas-oil separator plants at a pressure of 125 psig, compressing it to 2100 psig for injection. Any four of the five series connected, turbine-driven Clark compressors can provide the necessary pressure ratio for injection. Maximum flexibility is achieved by the use of dual shaft gas turbines. An additional Model 302 turbine drives a 5600 KW generator to power the gas-oil separator plants.

Turbines Power Aramco SCFD Gas Injection Plant

Proved dependability, minimum maintenance and the low installation costs experienced by other users of Clark gas turbines were important factors in selecting the turbines and compressors for the 'Ain Dar plant.

The fact that some of the Clark turbines and compressors could be delivered from the Olean plant and the balance from Italy, was also of prime importance to Aramco.

Clark 305 and 302 gas turbines have a standard rating of 8700-9300 bhp. 1220 bhp. models are also available. Consult your Clark representative for your next gas turbine or centrifugal compressor project or write for descriptive literature.

CLARK

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COMPRESSORS • GAS TURBINES

DIFFERENT TYPES OF PREHEATERS . . . drying damp pipe before priming, used left is a three-burner propane preheater. **AND DEFROSTERS,** to prepare very cold pipe for stringer-bead welding, and for on Transwestern project. Top left is a pan-ring for butane preheater, and bottom

weather varied. During that time daily footage of all spreads was fairly close.

At the end of the first 2 months of construction, the H. C. Price and Houston Contracting Co. spreads laying long joints were coming out of rough mountainous terrain into more open country. In the season of high winds which was approaching it was predicted that the long-joint spreads might have an advantage where they could lay more pipe in the morning. Thus they might weld more pipe footage for the day before high winds shut them down.

Although 80-ft. joints mean only half as many welds to be made on the right-of-way, the actual gain in footage over that for 40-ft. joints is variously estimated as from 10 to 30% because of the somewhat longer time to line up the longer joints.

For the Arizona section of Transwestern being laid by Price, the western spread started near the California border and the eastern spread started on the New Mexico side of the state. By February 12, 130 miles had been completed of the 336 miles in this section. This was accomplished in spite of unseasonal weather conditions as well as rough, rocky, and mountainous terrain. Output of 9,000 to 11,000 ft. per spread per day was regarded as what would normally be expected.

Automatic welding. Each of the two Price spreads is being supplied with double-jointed 80-ft. joints from a portable submerged-arc welding plant. In visiting the plant, temporarily located at Seligman, Ariz., it was learned that average output in a 10-hour day was 90 welds.

Welding was done as follows (with the pipe rotated):

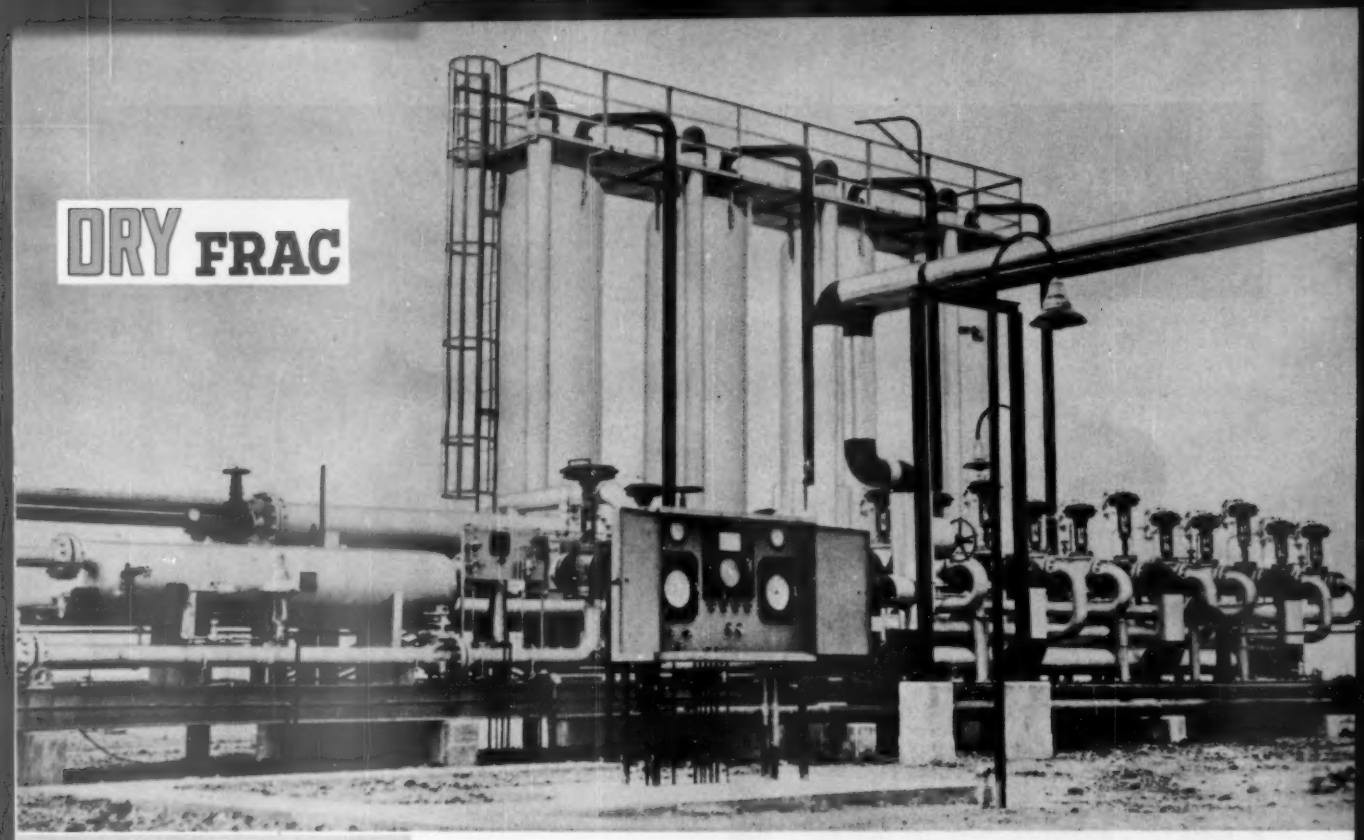
1. Outside sealer bead—800 amp., 33 volts, at 108 in. per minute;
2. Second outside bead—750 amp., 34-35 volts, at 55 in. per minute;
3. Inside bead—725 amp., 34 volts, at 55 in. per minute.

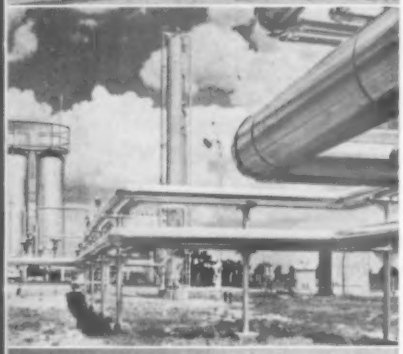
The double-jointing operation has not been shut down for cold weather even when temperature was near zero. At times operations have been interrupted because of difficulty in hauling pipe across muddy ground at the plant yard.

Special boom-tractor equipment has been developed by the contractor which can carry two 40-ft. joints at a time. This has saved time in moving pipe from the stockpile to the double-jointing unit.

Firing-line four-machine units. The appearance of the firing line of Price's eastern Arizona spread has been transformed by a revolutionary development in firing-line tactics.

There are no firing-line welding machines mounted singly or in pairs on sleds or trailers and pulled by tow





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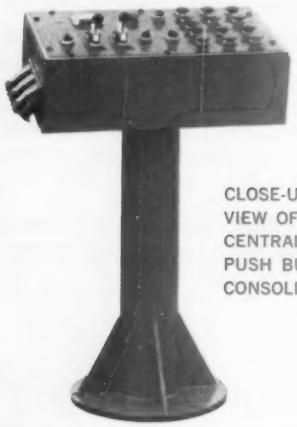
- 360° spray head eliminates build up or lap at juncture of spray pattern.
- Operator controls machine operation from centralized push button console . . . he does not have to ride boom car.



CLOSE-UP VIEW OF CENTRALIZED PUSH BUTTON CONSOLE.

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DOPE GANG applying coal tar, glass mat, and kraft paper.

RUNNING ELECTRONIC holiday detector, patching, and applying patch pad.

tractors from one welding position to another.

Four welding machines are mounted on each of three tractors. The welding machines are powered by the same tractor engine, on each unit, which drives the tractor. The four welders served by each tractor unit move forward together when the unit advances to the next set of welds to be finished.

Advantages of these tractor-welding machine units are as follows:

- Fuel saving is about 25%.
- Constant arc from the tractor engine drive makes it possible to do better welding.
- The units are more dependable.
- They can be moved about better over good and bad ground.
- They eliminate need for tow tractors.

Disadvantages (given below) are offset by the advantages:

- Investment is higher.
- If something goes wrong with a tractor-welding machine unit, four welders are idle. (So far little time has been lost.)
- There are three operators (one driving each machine), a larger number than is usually needed for tow tractors.

All welding machines in the pipe gang and the firing line are of the 300-amp. type.

The four machines serving the stringer-bead welders and the four machines for each of the three firing-line units are each mounted on Caterpillar D-7 tractors. The six machines for the hot-pass welders are mounted on a D-8 tractor.

Three to four welders run stringer beads. In the hot-pass crew there are four hot-pass welders and two strip welders.

The tractor-welding machine units in the eastern spread are all built according to the contractor's specification by Taylor Machinery Co., Memphis.

Only the eastern spread is equipped with the tractor-welding machine units. These have been so successful that eventually all of the company's spreads will have this type of equipment.

R. H. Fulton & Co.

The only one of the five spreads on the 30-in. main line to use 40-ft. joints entirely is that of R. H. Fulton & Co. laying the section in western New Mexico going up to the Arizona border.

Fast work in the pipe gang has been pacing this spread for large daily output. At the time of the author's visit, the spread was working in muddy and frozen ground in fairly level country near Grants, N. M.

Pipe was being added to the line in the pipe gang at the rate of 1½ to 2 minutes per joint while the work was being watched. Output was reported to be quite consistently 30 welds per hour. Average daily output in flat country was reported as 8,500 ft.; sometimes it would be as high as 11,000 ft. daily.

Instead of one, there were two D-7 boom tractors for setting in the pipe at the pipe gang. These were reported to be paying off by cutting down line-up time.

Three welders were running stringer beads. Following immediately behind the stringer bead welders there were eight welders—four hot-pass welders and four strip welders. Lineup was by air clamp. Joints were being preheated immediately before lineup even up to the middle of the day. A mechanic was assigned for full-time duty with the pipe gang.

There were 20 welders in the firing line. However, 15 to 17 were said to be the usual number.

All welding was single hand (with welding machines furnished by the contractor).

Stringer-bead and hot-pass welders were served by 300-amp. welding machines.

Strip welders and firing-line welders had 250-amp. machines.

SMALL TRACTOR with 42-in. blade for grading ditch for Houston Contracting Co. near Mountainair, N. M.

PADDING MACHINE screening and conveying fine dirt from spoil bank for padding pipe in the ditch on Houston spread near Roswell, N. M.

The new practice of mounting two welding machines together eliminates the need for one of the tow tractors.

Houston Contracting Co.

The two Houston Contracting Co. spreads were working at high elevations where they had had considerable snow, when they were visited at the end of January. At that time one spread was based at Mountainair in Central New Mexico, and the other at Roswell in southeastern New Mexico.

The one working out of Mountainair had been laying at 7,200-ft. elevation. A total of more than 50 in. of snow had fallen—the largest amount was 37 in. in one storm. Weather varied from snow, freezing cold—sometimes as low as 8° F.—to thaw. Nearly 3 weeks' time was lost by bad weather. Snow was clammed out of the ditch.

Terrain varied from easy and rolling to choppy and mountainous.

Pipe being laid was mostly 60-ft. and some 40-ft.

A small tractor with a 42-in. blade was being used on this spread to grade rough ditch bottom in rocky country. In such jobs it could do the work of 10 men grading by hand tools.

Welding crews of both of the Houston spreads were similarly equipped. The 300-amp. welding machines in the pipe gangs are each driven by the engine of the tractor on which they are mounted by a type of installation made at the contractor's shop. This equipment development was pioneered by Houston in recent years. Firing-line welders have 250-amp. welding machines, tie-in and utility welders have 200-amp. machines.

Firing lines had the usual type of individually mounted (and some double-mounted) welding machines.

Each of the Houston pipe gangs had three stringer-bead welders and four hot-pass welders. Firing lines had from 16 to 17 welders.

The special propane heaters (one type for preheating the pipe in the pipe gang and another type for defrosting just ahead of the cleaning and priming machine) had been designed and fabricated by the Houston organization.

The Houston spread based at Roswell was working at 6,500-ft. elevation when it was visited. Snow had fallen to depths of 4 to 20 in. in different storms. Temperature had been down to −4° F.; it had commonly been 20° F. in the morning and rising later in the day.

At the time of the visit, work was going on in the same area for the 30-in. main line and for one of the two 24-in. laterals which connected with it.

In rough country a policy was followed of mixing 40-ft. and 80-ft. joints to facilitate flexibility.

Fair average output was regarded as 5,000 to 6,000 ft. a day while working in the windy weather which is increasing as spring approaches.

This spread had extensive ditch-padding operations in rock country which had stretched for 50 miles.

Because of the large amount of rock in the backfill, dirt for padding had to be hauled on big scale from points where it was available in the vicinity of the ditch. Eight large earth movers were being used when the job was visited: five Caterpillar DW-21, one twin-engine Euclid, and two single-engine Euclids.

A Crose ditch padder of an improved type with 50% more capacity was operating where conditions were favorable for screening and conveying soft and rock-free soil from the spoil bank to the ditch.

General Information

Pipe for overland sections of the 30-in. main line is X-56 with 0.375-in. wall thickness. The 24-in. laterals feeding into the 30-in. line are X-56 with 0.312-in. wall thickness.

Coating is coal tar reinforced with glass mat and wrapped with kraft paper. For 25 miles of the discharge side of each station, high-melt coal tar, glass mat, and felt are used.

Stringing. In New Mexico and Arizona, stringing trucks carrying 30-in. pipe are loaded with three 80-ft. joints or five 40-ft. joints.

Snow removal. In an effort to get a better method than that of clamming snow out of the ditch, there has been some experimenting with a snow blasting method and with an improvised spiral conveyor powered by a small tractor. These experiments were not satisfactory.

Preheating. The project requires

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Bitumastic coatings resist 11 years of abrasive salt-water attack

Loading docks of Public Service Electric and Gas Company's Sewaren Generating Station are subjected to unusual corrosive attack by the Arthur Kill, a bay-like tidal river between New York and Staten Island. Added to the river's salt water content are floating debris and effluent from industries and oil refineries located along its shores.

To cope with these severe corrosive elements, 11 years ago Public Service's engineers specified that the steel piling for the station's loading docks and sea wall be coated with Bitumastic® No. 50. For added weathering protection, piling exposed above the low-tide level also was given an additional coating of Bituplastic® No. 28.

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LARGE EARTH MOVER, moving fine dirt for padding in Houston operations near Roswell.

that contractors preheat the pipe before running the stringer bead. Temperature of 120° F. is regarded as satisfactory. During winter months it has been cold enough every morning for preheating.

There has been no uniformity in the types of preheaters used in the different spreads. At one spread where an acetylene flame (applied by two men with torches) was inadequate, a decision was reached to change to a kerosine type of preheater.

Butane preheaters applying flame in a panlike frame have given good service at two spreads. Flame ignited by a pilot light flares out full circle in the pan ring and heats the pipe in less than half a minute.

A propane heater designed and made by one of the contractors is used on two spreads. This has a fixture with three burners which is inserted in the pipe.

Defrosters for drying the pipe ahead of the cleaning and priming machine consist of housings put over the pipe to confine the heat from a flame swirling around the pipe.

Assistance in making the trip along the line and in getting information for this article was given by N. C. Turner and Paul McBride, Transwestern Pipeline Co.; N. F. Blundell, Gulf Interstate Co.; H. C. Price, Sr., and H. C. Price, Jr., R. K. Shivel, R. L. Ezell, G. A. Reutzel and K. George, H. C. Price Co.; K. O. Peterson, F. C. Talley, and H. L. Spraggins, R. H. Fulton & Co.; R. P. Gregory, L. A. Young, and M. L. Thompson, Houston Contracting Co.

Conclusion

The Transwestern project stands out as the greatest pipeline project under construction in the U. S. this year. It is one of the largest ever built as a single undertaking. Main lines, laterals, and gathering lines will total close to 1,800 miles.

In pipeline history it will be notable for pioneering the use of X-56 pipe on a very large scale.

Since the time when pipe laying started on the 30--in. line in November and December 1959 the five spreads have shown that good progress can be made in laying big pipe through tough winter and mountain conditions.

When the job is finished, progress records may clarify the status of 80-ft. joints under various conditions.

There seem to be three different attitudes toward the 80-ft. joints:

1. They will pay off in level terrain.

2. They are worth using on mountainous, hilly, and level terrain but they really do not save money on a good job. They are advantageous for reducing risks on a bad job.

3. They are good for good as well as bad jobs in varied terrain. You cannot calculate in advance all the economies accruing from doing only half as much welding on the right-of-way, from taking advantage of breaks in the luck which come with faster progress and from getting the job finished earlier. These economies may generously offset costs incident to a double-joint program.

The final scores for this project may bring answers to the questions that have been raised.

BACKFILLING DITCH with dozer on 50-mile stretch of very rocky ditch in Houston's section near Roswell.

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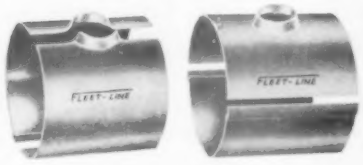

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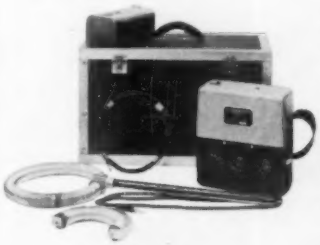

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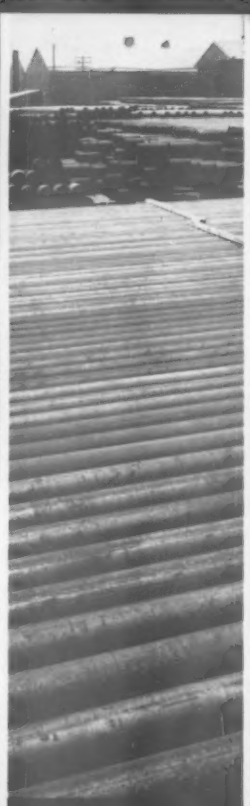

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- Demand is rising faster than reserves are being added.
- Full deliverability of present reserves could taper off before all present pipelines and distribution systems are amortized.
- Guesses of ultimate reserves yet to be found ignore practical problems and economic incentive for required exploration.
- The economic significance of the recent shift from shallow dry gas to deep wet gas as the major source of supply has not been fully appreciated.
- The search for oil alone will not increase gas reserves enough to keep pace with the rate of consumption.
- Revenue from gas sales must supply the major incentive to explore for new gas reserves.

Editor's note

This significant article is based on studies of long-range trends in the supply and demand for natural gas conducted by Phillips Petroleum Co. in connection with its rate investigation now pending before the Federal Power Commission (Docket G-1148).

At the request of four New York banks the basic material was presented to a large group of financial men in New York City, December 2, 1959, by H. K. Hudson, associate general attorney, who argued the Phillips case before FPC. Others who aided in its preparation were C. E. Turner, manager, economics department; R. L. Howard, natural-gas department; C. M. Allen, general natural-gas geologist; and Jack Tarner, production department.

Because of the significance of the trends shown by this study, The Oil and Gas Journal requested permission to present this article condensed slightly from the oral presentation.

1. Supply and Demand Trends

WE HAVE no crystal ball with which to predict the future of domestic gas reserves. But statistical and economic studies we made for our pending case before the Federal Power Commission show certain trends that have important implications for gas pipelines, gas distributors, and gas consumers.

The present total depreciated investment of natural-gas pipelines and distribution companies is about $14 billion—$6 billion in pipelines and $8 billion in distribution companies. The gross investment is $18 billion.

The American Gas Association is now estimating that, by 1970, the gross investment in pipelines and distribution facilities will increase to $49 billion, or almost triple. To supply the gas for these facilities, that association estimates that the annual production rate must increase from about 11½ trillion cubic feet in 1958 to 18 or 19 trillion cubic feet by 1970.

Natural gas is of course an exhaustible natural resource. For every natural resource there must come a time when production will fail to meet the potential demand and a time when production will actually decline.

For gas pipelines and distributors, the paramount question is when will the time arrive when the available volumes of natural gas no longer fill the pipelines? If that time comes before the pipeline investments have been retired, unit transportation and distribution costs of gas are going to have to go up, entirely independent of any increase of gas prices in the field.

It is our hope that that time can be deferred for a good many years but it is certain that the only way that it can be deferred is by an increased search for natural-gas supplies in the United States. What we propose to show is where the trend is headed now.

Economics of substitutes. Of course, if there were a cheap substitute for natural gas readily available, we might not have to worry about a future supply of gas. But, there is no cheap substitute. The vast supplies of shale oil, tar sands, and foreign oil will be available for the future use of the motorists and other users of oil products but they offer no supply for the gas consumer in competition with pipelines.

One basic reason for this is the disparity in the values of natural gas and oil on an equivalent-energy basis. One barrel of oil is approximately equal to 6 M.c.f. of gas. So, at a price for oil of approximately $3 per barrel, the value of the oil equivalent of 1 M.c.f. of gas is about 50 cents as compared with an average of about 12 cents per M.c.f. for natural gas in the field.

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sideration the cost of converting oil to gas. Clearly, whenever the vast reserves of shale oil and tar sands are developed, they are more likely to be developed for oil than for gas.

Recently there has been a flurry about transporting liquefied gas to markets by tanker. Two executives of Constock International Methane, Ltd., the pioneers in that work, have stated that liquefied gas cannot in the foreseeable future be a substitute for pipeline gas in this country, except possibly for peaking purposes. Phillips has a large supply of gas in Venezuela and is interested in a market for that gas.

Our estimates show a rock-bottom cost for liquefied methane delivered by tanker to the East Coast on a 100% load factor basis of 85 cents to $1 per M.c.f. That is about twice the cost of 100% load factor pipeline gas delivered to the distributor in New York. Liquefaction of methane may have a future for storage and peaking purposes; but for the foreseeable future we believe its use, even for peaking purposes, will be for storage of pipeline gas produced from wells in this country.

Canada's proved reserves are about 10% of those of the United States and its population is also about 10% of that of the United States. Both its population and its industry are growing rapidly. We will get some gas from Canada as well as Mexico, but it will be insignificant as compared to our tremendous demand.

2. "Paper" Reserves vs. Proved Reserves

So, it is clear that the gas consumers of the United States must look to natural gas produced from wells in the United States. With that in mind let us take a look at what the prospects are.

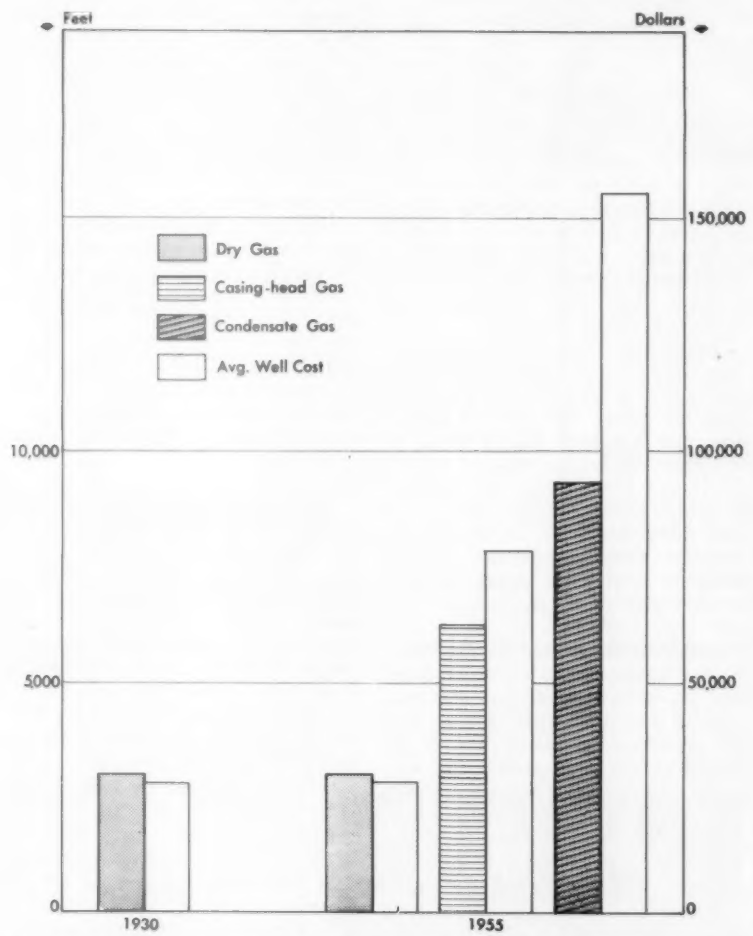
The American Gas Association estimates total proved gas reserves as of the end of 1958 were 254 trillion cubic feet. There have also been some figures published of possible or potential volumes of gas occurring within the United States far in excess of those proved reserves.

Lewis G. Weeks, president of the American Association of Petroleum Geologists, calculates an ultimate volume of 1,000 trillion cubic feet. In a 1957 publication by Chase Manhattan Bank, Terry and Winger calculated a possible ultimate volume of 1,200 trillion cubic feet. Ralph L. Miller, of the United States Geological Survey, has calculated a possible ultimate volume of 1,700 trillion cubic feet.

These figures of 1,200 trillion and 1,700 trillion cubic feet have been used by certain people for purposes which were never intended by the authors of the figures. In the Phillips rate case before FPC and in several other rate cases before the commission, economists have testified and have used these figures with a broad brush as support for their argument that there is no great need for any special effort to find additional volumes of gas.

Nothing could be further from the truth. In every case the authors of these calculations have specifically stated the exact opposite.

These calculations of possible volumes of gas ultimately present under the earth's surface should not be confused with calculations of "proved" and "probable" reserves of gas determined from actual exploration and development. They are mere calculations of possibility made by mathematical extrapolation from the known to the unknown. The authors do not undertake to say in what counties or even what states these volumes of gas may occur or at what depths they may occur or whether the gas will be in profitable reservoirs or in marginal reservoirs.



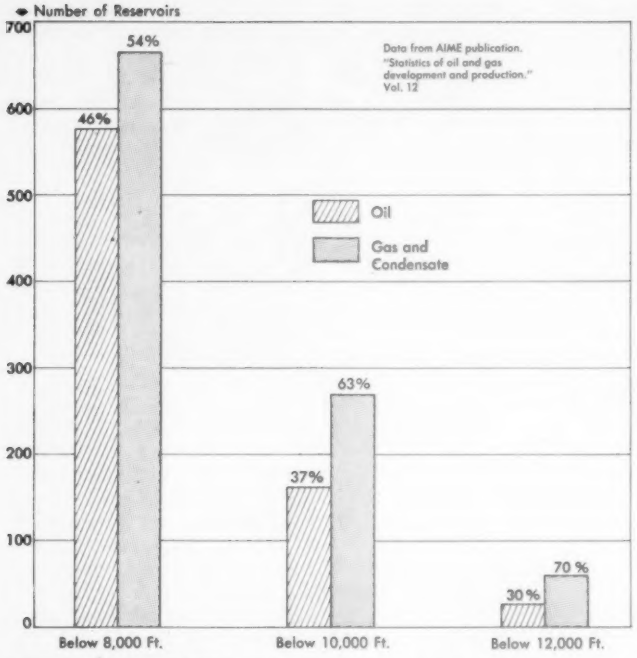
DEPTH AND COST of wells producing marketed gas shows significance of transition from dry gas to deeper casing-head and condensate gas. Fig. 1.

The real issue. It really makes little difference whether these projected volumes of 1,000, 1,200, or 1,700 trillion cubic feet are or are not present beneath the earth's surface. The real question is what volumes of gas are we finding and what efforts are we making to find more.

The authors of these calculations make it clear that it is the proved reserves on which the pipelines and distributors must rely. They clearly recognize that a large part of these 1,000, 1,200, or 1,700 trillion cubic feet may be in the category of the low-grade iron ore in this country which we presently cannot work.

3. How Are We Doing?

Consider some of the problems with which the industry is faced in finding these proved reserves and how well it is doing in finding them. First, it must be kept in mind that the search for gas by the industry is totally unlike a situation such as that of an individual electric-generating company which can invest a certain amount of money and expect to produce a given amount of



PRODUCING RESERVOIRS of Texas and Louisiana Gulf Coast show increasing odds for finding gas—if the operator finds anything—at these depths. Fig. 2.

energy which can be turned on at any given time.

In the case of oil and natural gas, the volume that is found is the result of the total effort of all of the industry. Start a hundred children on an Easter egg hunt and very soon one of them will find the golden egg. Start only two children on the same hunt and they may never find it.

Similarly, the total volume of gas is the result of the total effort of all of the participants including the efforts of those who do not find anything as well as the efforts of those who do and, obviously, the only way that the entire industry can be induced to continue its efforts is for it to have an incentive which it considers adequate. The incentive to the industry to continue the search must lie in the prices of the products which the industry finds.

Now, how is the total effort of the industry keeping up with the demand for gas?

Changing discovery pattern. Thirty years ago when the first major interstate pipelines were being constructed, we had enormous shallow dry-gas reservoirs. The Panhandle-Hugoton reservoir of Texas, Oklahoma, and Kansas at a depth of about 3,000 ft. had an original reserve of nearly 70 trillion cubic feet. No other gas reserve has ever been found anywhere in the world remotely comparable to the Panhandle-Hugoton.

The San Juan Mesaverde reservoir of New Mexico and Colorado at about 5,500 ft. and less had 14 trillion cubic feet, Monroe field of northern Louisiana at 2,000 ft. had 6 trillion cubic feet, and Carthage field of East Texas at 6,000 ft. had a little less than 6 trillion cubic feet. Now the Panhandle-Hugoton is nearly half gone, Carthage is more than half gone, and Monroe is nearly all gone.

In the past 10 years no single reservoir has been discovered that had reserves as much as the smallest of those four reservoirs. The offshore CATC sale that has been talked about as having a tremendous reserve took 5 fields and 27 reservoirs put together to total a reserve of less than 2 trillion cubic feet. All of the CATC reservoirs underlie the ocean and they range in depth from about 5,000 ft. to more than 12,000 ft.

Fields are deeper and smaller. Some of the results of the transition from dry gas to casing-head gas and condensate gas, the deeper drilling, and the greater costs associated with the deeper drilling, are shown in Fig. 1.

In 1930, virtually 100% of all pipeline gas was dry gas from the Appalachian area and Monroe and Panhandle fields from depths of 3,000 ft. and less. The well cost at that depth is $28,000. By 1955, the latest year for which data are available, dry gas represented only 43% of the total. The remaining 57% was 26% casing-head gas and 31% condensate gas. The average depth of wells producing casing-head gas was 6,200 ft. and the average depth of condensate wells was 9,300 ft.

The increase in the cost of drilling to the average depth of these wells was even more dramatic. The average cost at the average depth of wells producing casing-head gas was $78,000 and the average cost at the average depth of condensate wells was $155,000. Many of the deeper wells cost more than a million dollars. These are only the drilling costs. Other costs, particularly the cost of exploration, have risen far more rapidly than general inflation.

4. Is Gas Found "Accidentally"?

In producer hearings before FPC, economists, appearing for distributors, have taken the position that gas is found incidentally in connection with the search for oil and that it will continue to be found in adequate supplies in the search for oil.

It has been incomprehensible to us that any representative of the multi-billion-dollar distribution industry would advocate, before FPC or anywhere else, that his industry's future supply of raw materials should depend on accidental discovery by producers who they say are looking for something else. Surely these economists do not express the true beliefs of the distributors.

At any rate, let us consider the facts as to what the industry is looking for. In our hearing, we presented much evidence that, as the industry drills deeper and deeper, we are finding less and less of oil and gas per foot drilled and the proportion of oil to gas has decreased so that more and more the industry must depend upon its revenues from gas to carry on its further exploration.

Why do we drill? As an example of this, Fig. 2 shows, for the total of all producing reservoirs below 8,000 ft. in the Gulf Coast area including offshore, the ratio between gas and gas-condensate reservoirs on the one hand and oil reservoirs on the other. Below 8,000 ft., 54% are gas and gas-condensate reservoirs and 46% are oil reservoirs. Below 10,000 ft., 63% are gas and gas-condensate reservoirs and 37% are oil reservoirs. Below 12,000 ft., 70% are gas and gas-condensate reservoirs and only 30% oil.

Clearly, anybody who drills below 8,000 ft. in that area should do so with the knowledge that, if he gets anything, it is considerably more likely to be a gas or gas-condensate reservoir than an oil reservoir. During the last 7 years, the average depth of all ex-

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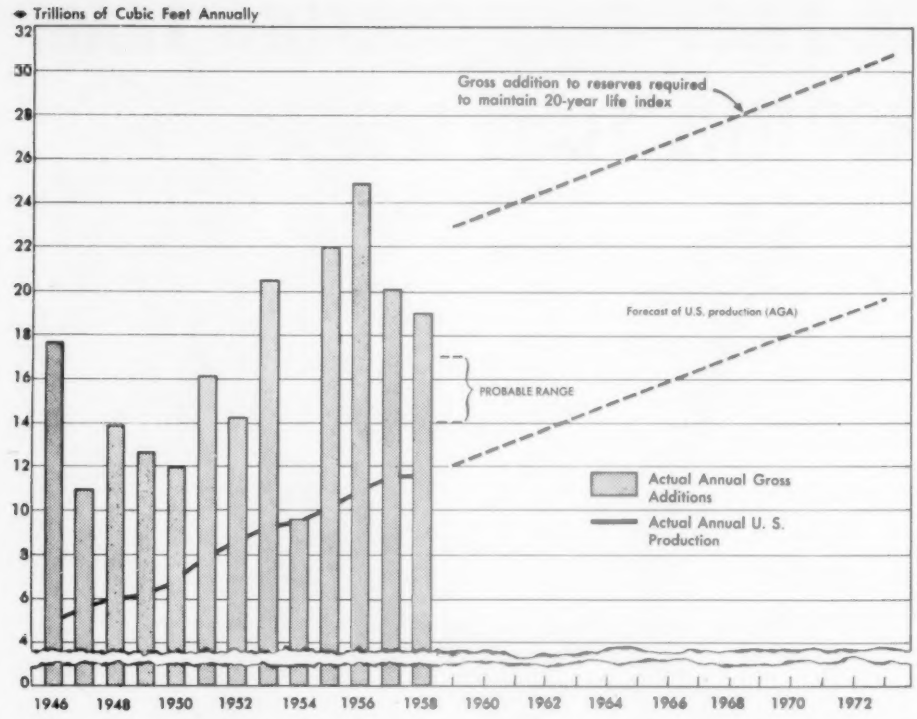

GROSS ANNUAL ADDITIONS to natural-gas reserves required to meet forecast U. S. production are compared with the record. Fig. 3.

ploratory wells in South Louisiana has been greater than 10,000 ft. This chart shows that at that depth, if you find anything, the chances are almost two out of three that it will be a gas reservoir.

Obviously the producers who are drilling exploratory wells in this area are not drilling primarily for oil. The price of gas has to be a very important factor in determining whether or not they will drill. While the ratios shown on this chart would not necessarily obtain in all areas, the fact remains that in practically all areas the income from gas has become an increasingly important part of the producer's income out of which he must pay his exploration costs.

The same economists who testified that gas is found accidentally in the search for oil also testified that the prices for oil rather than the prices for gas will control the amount of exploration. Certainly, in the great Gulf Coast area which is one of the new and promising areas for future supplies of gas, the continued search at great depths will not be controlled by the price of oil.

5. Can We Meet the Demand?

Now, with the industry facing deeper drilling, increasing costs, and greater dependence upon income from gas rather than oil, let us see how the industry has been doing in discovering new reserves of gas to meet the increasing demand and in continuing the search for new and future supplies.

Fig. 3 shows actual gas production from 1946 through 1958. It also shows the AGA forecast of required production from 1958 through 1973. This estimate was made early in 1958. Quite recently the AGA has raised its estimate of market requirements. That means that the production estimate would have to be raised to approximately 19 to 20 trillion cubic feet by 1970.

The solid bars on the left side of Fig. 3 are the reserves added from 1946 through 1958. The broken line in the upper-right portion of the chart shows the gross addition to reserves required to maintain a 20-year life index based on the AGA forecast of demand. The life index is simply the proved reserves divided by the current rate of production. Our engineers do not even refer to this relationship as a "life index." They and Terry and Winger refer to it properly as the "reserves-production ratio."

The "life index" fallacy. This life index or reserves-production ratio is sometimes mistakenly thought to represent the period of years for which a full supply will be available. It does not. In the case of most wells, as the gas is withdrawn, the pressure declines and the rate at which the well can produce declines. The result is that the number of years during which a well can produce a fixed volume of gas is much less than the years indicated by the life index.

For example, take the case of a well with 20 billion cubic feet of reserves behind it. If you undertake to produce that well at a fixed rate of 1 billion cubic feet per year, the well can only produce at that rate during its early life and after that the volumes will decline so that by the twentieth year the well would be producing much less than the 1 billion cubic feet per year. It might be producing a small volume 50 or 60 years later.

Generally speaking, the same thing is true for all of the wells and reservoirs which produce the nation's gas supply. Our reserves engineers refer to this point when a well or reservoir or group of reservoirs can no longer produce at a given fixed rate as the "breaking point." In other words, the volumes begin to decline, or break, at that time. Our reserves engineers testified, without challenge, that the 22-year life index in 1956 represented about 14 years of full-line deliverability. In other words, the breaking point was only 14 years away.

Full lines for how long? Now what does this 14-year period of full-line deliverability mean? It means just this. If, beginning as of the time of our testimony, there would be no further expansion of the gas markets and if there would be no further finding of additional reserves of gas, the supplies of gas then available would continue to produce the then market requirements for only 14 years. After that time the volumes would decline and the pipelines would be operating at only partial capacity.

Of course, we are not suddenly going to stop expanding and we are not suddenly going to stop finding gas but that 14-year figure is a perfectly valid and very valuable datum or reference point to start from. Beginning with that reference point, if the market demand continues to expand

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as the AGA is estimating and if the industry does not find an adequate volume of reserves, then, as we go forward, we will be rapidly shortening that full-line deliverability period. In other words, on the average, every pipeline will have a shorter and shorter future life of full-line deliverability.

Some people think that if we add new reserves each year equal to the volume produced we are all right. That idea is not only naive, it is folly. To do just that would mean that we would maintain the proved reserves just where they are at 254 trillion cubic feet. But as you can see from Fig. 3, when we would get to about a 20-trillion production rate in 1970, our life index would be only 12½ years. Also, due to the nature of gas reservoirs, the ability of the wells to produce declines much more rapidly than the rate at which the gas is withdrawn.

For example, on the average, when 50% of the reserves remain, the wells have only about one-third of their original ability to produce. Our engineers estimate that by 1970 when our life index would be only 12½ years, our breaking point, or the time we can no longer supply the full demand, would be only about 2 or 3 years away. By 1973 it would have arrived.

6. Reserves Needed for Tomorrow

It has been rather generally recognized, by distributors' witnesses before FPC as well as by our own experts and others, that a 20-year life index is about the minimum required to be maintained by the industry. Our reserves engineers testified that the 22-year life index, or reserves-production ratio, for the country represented a 14-year period of full-line deliverability. They now estimate that a reduction to a 20-year life index means a period of full-line deliverability of 13 years or less.

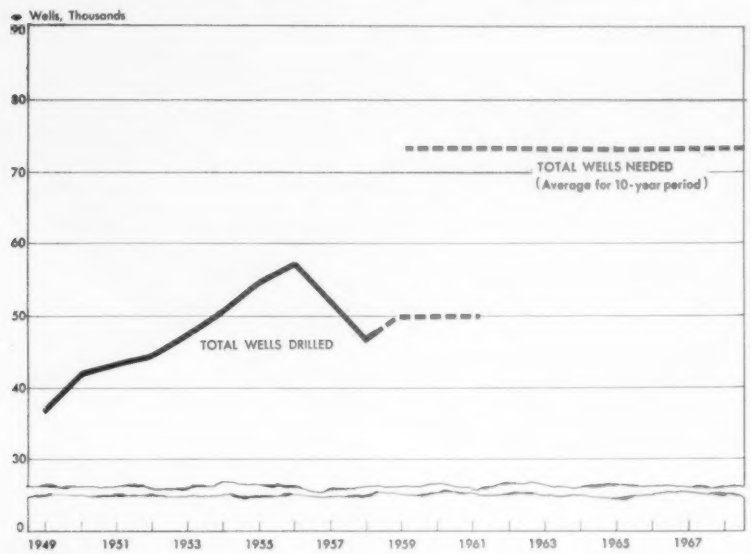
So, since bonds are usually issued on a 20-year basis it should be obvious that a 20-year life index must be about the minimum. It's easily calculated that in order to meet the estimated required annual production rate of 15 trillion cubic feet by 1965 and to maintain this minimum (20-year) life index, we had to find from 1956 through 1965 additional reserves at the rate of approximately 23 trillion cubic feet per year.

Now, observe what happened in 1957 and 1958. In 1957 we added only 20 trillion and in 1958 only 19, both way below the required 23 trillion average.

Our reserves engineers cannot make an accurate estimate of what the reserves added will be for 1959. However, considering the fact that there have been no outstanding findings during the year, they have difficulty in seeing how the reserves added for 1959 could be greater than 15 trillion cubic feet. In any event, they believe that the figure will be somewhere between 14 trillion and 17 trillion cubic feet and we have indicated that range for 1959 in Fig. 3.

If our engineers are right about the reserves added for 1959, the required findings for the remaining years will have to be at an average per year higher than the 24.8 trillion of 1956 which was by far the largest volume that we have ever added in any single year.

In a recent speech to the Mid-Continent Oil and Gas Association, Ralph E. Davis, an eminent geologist associated with the gas business since its beginning, stated that during the next 13 years we probably would not equal the average added during the last 13 years. That average was only 16½ trillion cubic feet.



WELLS DRILLED annually in the U. S., and the indicated rate through 1961, are well below the forecast of wells required to meet gas demand. Fig. 4.

Drilling and reserves trends. Now look at the drilling rate in Fig. 4.

In a recent speech, C. E. Loomis, senior vice president of Columbia Gas System, stated that, in order to meet the demand during the next 10 years, the industry will have to drill 735,000 wells. This is 73,500 per year, or an average of over 1½ times as many wells as were drilled in the last 10 years.

The broken line in Fig. 4 represents Loomis' estimate. The solid line shows the actual wells drilled in the last 10 years. Observe the sharp drop in the total number of wells drilled from 1956 through 1958, down to 47,000 wells. Based upon published figures to date, the total number of wells drilled in 1959 approximated 50,000. The highest estimated figure that we have heard for 1960 is 3% above 1959.

However, our management believes that the figure for 1960 will be no higher than for 1959. Going one step further, in the recent estimate made by the McGraw-Hill economics department, for future capital expenditures, it estimates that the expenditures for drilling and producing in 1961 will be the same as for 1960. So on this chart we have indicated the total number of wells to be drilled in 1961 as being unchanged from 1960.

The 1957 Chase Manhattan report estimates the completion of 735,000 wells during the decade ending in 1966, culminating in the drilling of 87,000 wells in 1966. If Loomis and the Chase Manhattan authors are right about the total number of wells that must be drilled by 1968 to meet the estimated gas demand, the total effort of the industry will have to be increased tremendously.

From Figs. 3 and 4 it is obvious that the more wells that are drilled, the more reserves that are likely to be added; and the fewer drilled, the less the reserves likely to be added. Figs. 3 and 4 show there is a general relationship between the wells drilled and the reserves added. The estimated number of wells to be drilled in 1960 and 1961 as shown in Fig. 4 certainly do not indicate any sharp reversal of the downward trend in reserves added.

If our engineers are right in their belief that the reserves added in 1959

(Continued on page 173)

When this went on location . . .

these went into stock

It may be a little bit difficult to see the connection between a triplex pump being installed on a waterflood project, and a shipment of rubber pails arriving at a nearby National Supply Store—but one is cause, the other effect!

A very important part of the store manager's business is to know what is happening in the territory . . . *and what the happenings mean in terms of new parts or product needs.* When this store manager got word of waterflooding plans, he knew that some of the operators would have to handle alkalis and acids that would mean sudden death to metal containers. So—he ordered rubber pails to do the job.

Currently, we look to thousands of suppliers to provide us with products and the list has to be frequently expanded, as in this instance. The products vary widely—but they all have one thing in common. Each one is made by an established manufacturer, with a proven reputation for quality and reliability. Link-Belt—Westinghouse—Diston—Scott—Marsh—Fyr-Fyter—FMC—Minnesota Mining and Manufacturing—names like these . . . names you know and trust . . . are on every product sold by National. The integrity of the maker added to the integrity of the seller, provides a double guarantee on every item you obtain from National Supply.

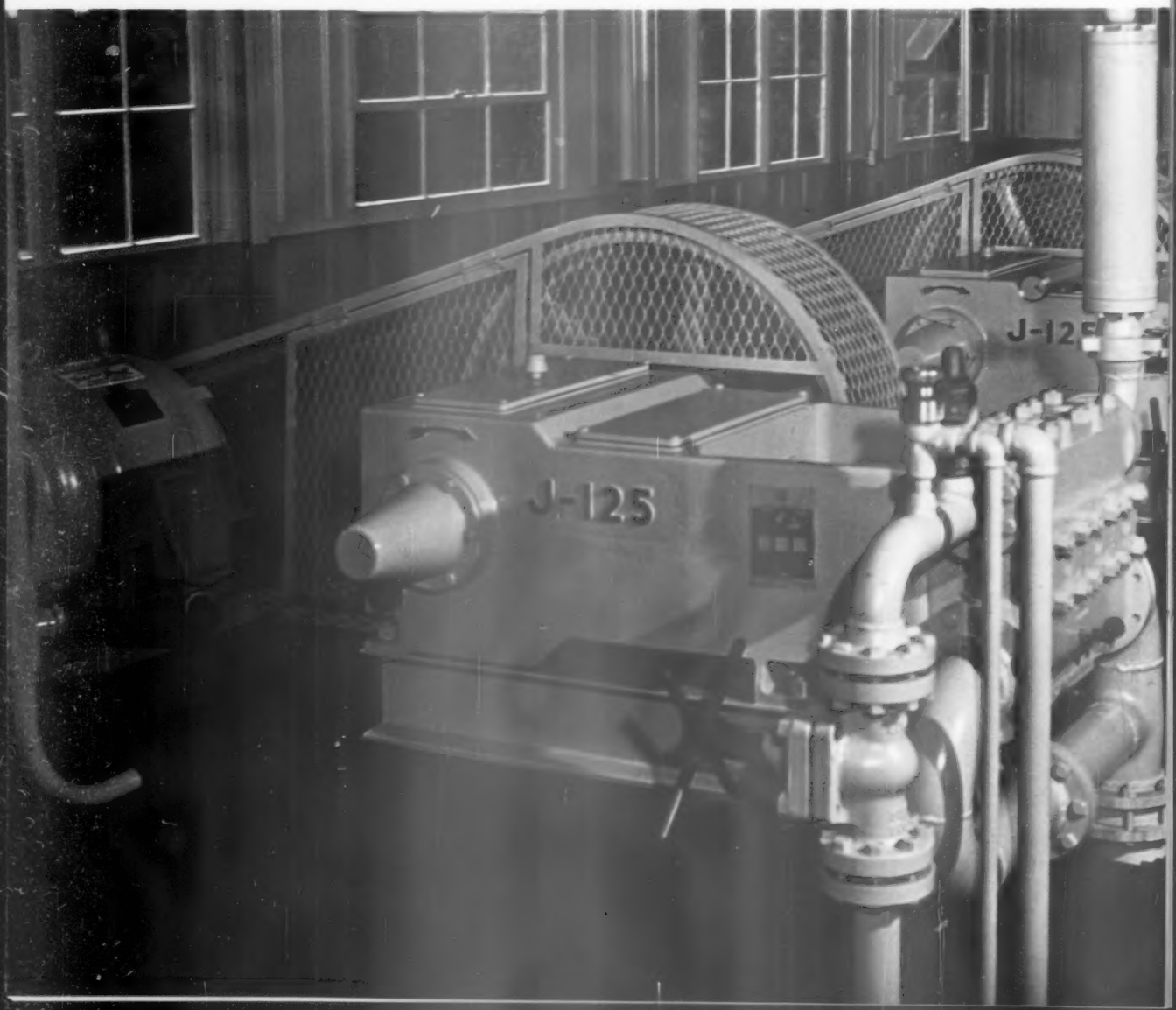
Why National's J-125 Triplex is a smooth running, versatile pump

When any production or drilling unit is made by National, you expect it to have no compromises in design or materials. This is true of the J-125. But check further—see the specific reasons why this pump will perform better than any other in its class. In the J-125, you get—

A BUILT-IN SUCTION DAMPENER—Runs the full length of the cylinder, directly beneath suction valves, to provide optimum dampening effect. The dampener keeps harmful surges from entering suction piping, promotes better filling . . . makes your overall pumping operation smoother and quieter.

FLUID END FLEXIBILITY—Three fluid ends are available for pressures to 6,000 psi (1) low pressure-high volume service (2) medium pressure-medium volume service (3) high pressure-low volume service. Each is available for corrosive or noncorrosive conditions. Ceramic, Colmonoy-coated steel and piston ring plungers (for power oil service) are available in a wide range of sizes.

Four compact J-125 Triplex Pumps are the core of the Mink Island Water Flood plant near New Harmony, Indiana.



Every triplex pump manufactured by National gets a break-in test run up to full rated speed and pressure before it leaves the plant. Fluid cylinders are hydrostatically tested to at least twice rated pressure before assembly of the complete pump.

A DOUBLE EXTENSION CRANKSHAFT — Permits use of a direct connection or a V-belt drive without reversing the crankshaft . . . also enables you to connect auxiliary drives such as chemical or sump pump in addition to the regular drive.

EASY ACCESS TO PLUNGERS, STUFFING BOXES—Ample space in the cradle chamber makes this possible. You can remove plungers or replace packing without removing stuffing boxes. If you choose to remove stuffing boxes, you never disturb the fluid cylinder.

A REPLACEABLE INTERMEDIATE ROD—You replace it without disturbing crosshead or plunger stuffing box. The rod stuffing box seals are grease packed for positive sealing and long service life.

CONTROLLED VALVE FIT—Shouldered, tapered valves give a positive fit. You can remove suction valves without bothering stuffing boxes.

POSITIVE SPLASH LUBRICATION—Used on all pumps operating from 160 to 400 rpm.

LONG PACKING, PLUNGER LIFE—Stuffing boxes fit in a pilot bore in the rib-reinforced main frame, assure proper alignment with plungers. Packing is kept in good condition by lubrication through a grease fitting on the stuffing box.

Don't settle for less than the best in a plunger pump. See the National Supply representative in your area about the J-125.

National High Drive Pumper on the next page . . .

The considerably smaller base required for the High Drive unit makes it ideal for remote locations where foundation costs are high.

NATIONAL HIGH DRIVE Pumper insures easier, low cost installations!

Here's the ultimate in low-cost pumping unit installations—the National *High Drive*. The concrete base for this compact, easy-to-handle pumping unit is much smaller than that needed for other units, so you save on foundation costs. Installation costs are also reduced by the platform-mounted electric motor which permits the use of shorter belts. And because they're elevated, the motor and belts are protected from the damages of blowing sand and high water.

Other outstanding features of the National *High Drive* are:

- Less expensive drive accessories and V-belt replacement
- More compact and easier to handle than pumpers of equal capacity
- Brake lever elevated for convenience
- Elevated platform rigidly constructed

The National representative in your area can furnish more details on these features, as well as all sizes of the National *High Drive* available. Ask him soon.

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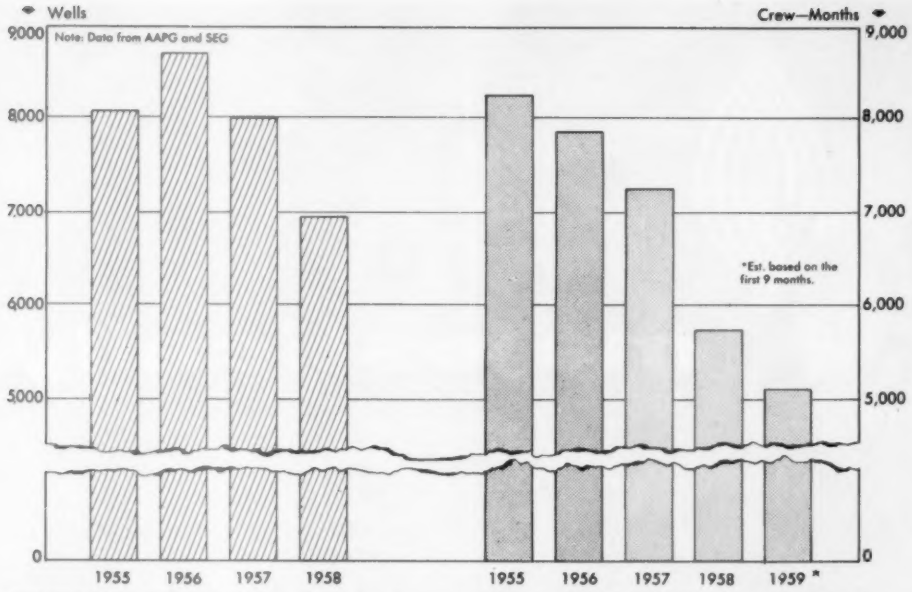


EXPLORATION DECLINE is shown by the downward trend of wildcat drilling at left and of geophysical activity at right. Fig. 5.

(Continued from page 168)

will not equal the 19 trillion cubic feet added in 1958, this will be the first time in all the years since the AGA began making these estimates that there has been a continuous downward trend in the reserves added for 3 successive years. The nearest approach to such a situation was from 1948 to 1950 when there was a small reduction for 2 years.

7. Total Exploration Lags

The decline in the exploratory efforts of the industry in the United States in the last 4 years is shown in Fig. 5. Obviously, the volumes of gas that the consumers get are from fields which have been or are being developed. Those fields were discovered in previous years by rank, or new field, wildcat wells and many of those wildcat wells, in turn, were drilled on structures that were located in still earlier years by geophysical exploration. So, the total number of wildcat wells drilled in any year tells us the extent to which the industry is looking for new fields and the total geophysical operations tell the extent to which the industry is looking for new structures on which to drill wildcat wells. In other words, the two together tell us which way the industry is headed in its total effort to supply the gas required by the consumers.

Wildcat trend. The number of wildcat wells drilled fell off in 1957 and 1958. It declined from 8,709 to 6,950, a drop of 20%. If the national average of 1 discovery for each 9 wildcat wells drilled is accepted, then nearly 275 new fields were not found during this period due to the decline in wildcat drilling from the 1956 rate.

Of course, many of these finds would have been noncommercial, and many more marginal. However, after development, some of these unfound fields would probably have added substantial reserves to the national total.

The figures for new field wildcat wells are prepared by the American Association of Petroleum Geologists and the figures for 1959 will not be available until this month. However, from data in other publications regarding exploratory drilling, it appears that the number of such wildcat wells for 1959 will be approximately the same as for 1958.

In updating this or the other charts, care should be taken to use the same sources and classifications of data as were used originally.

Geophysical activity. The number of months worked by geophysical crews has declined from 8,240 in 1955 to 5,731 in 1958, or a drop of 30%. Based on the figures for the first 9 months of 1959, the total crew-months worked in 1959 will show a continuing downward trend and be only slightly above 5,000. That is the lowest level of geophysical activity since the end of World War II.

Certainly, if the industry does not increase the tempo of its search for structures and fields in the United States we won't even have enough discovered but undeveloped fields in which to drill the total wells referred to by Loomis.

Offshore prospects. Much has been said about the great possibilities of the offshore gulf area, as a future source of gas. We do not know how much gas will ultimately be discovered in the offshore gulf area, or, for that matter, the whole United States, but we do know that, if the industry is going to find it in time to meet the enormous national demand estimated for the next 10 or 11 years, it is going to have to step up the search considerably.

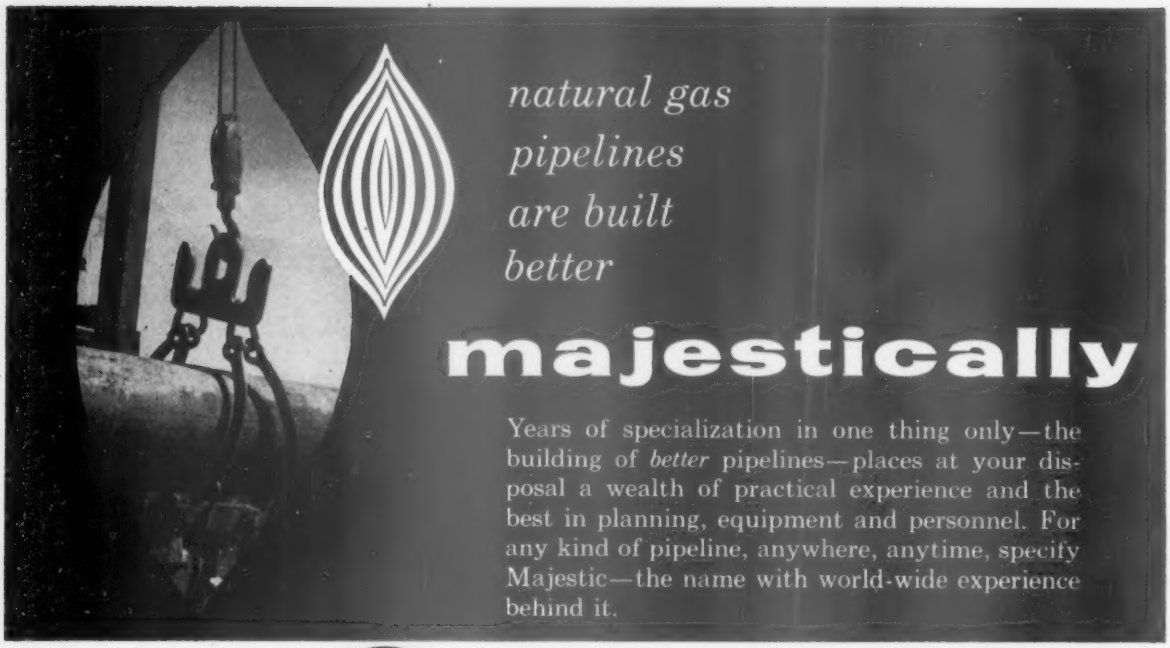
Fig. 6 is the same type chart as Fig. 5, except that it applies to the offshore Louisiana area only. In that area the number of wildcat wells drilled by the industry has declined from 66 in 1956 to 23 in 1958. In the first half of 1959, 11 wildcat wells were drilled so we have indicated 22 wildcat wells for that year. Present indications are that that figure is too high. This decline in wildcat wells in the offshore Louisiana area was a 65% decline from 1956 to 1958 as compared to a national decline of 20% during the same years.

Fig. 6 shows that the decline in geophysical operations in the Louisiana offshore area has been tremendous ever since 1955 except for an indicated slight increase in 1959 over 1958. Here the decline was from 403 crew-months in 1955 to 75 crew-months in 1958. This was a decline of 81% for the offshore Louisiana area as compared with a decline of 30% nationally in the same period.

8. What These Trends Mean

Now consider the import of the trends reflected by these charts, in the light of the financial situation of the pipelines and distributors. The average depreciation rate allowed to the pipeline companies is about 3% per year, which assumes a life, at efficient levels, of approximately 33 years.

The gas-distribution companies are allowed depreciation rates as low as 2% per year, which assumes a life of 50 years. The gross investment in the pipelines and distribution facilities is about $18 billion and the net investment is about $14 billion. In other words, the pipeline and distribution



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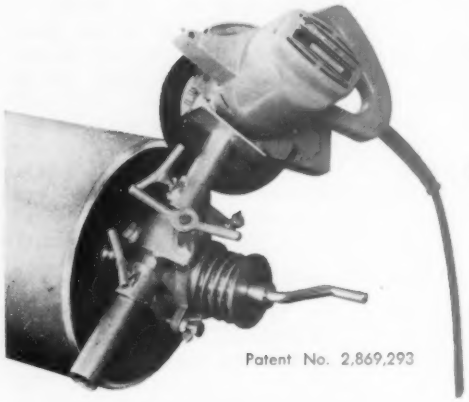

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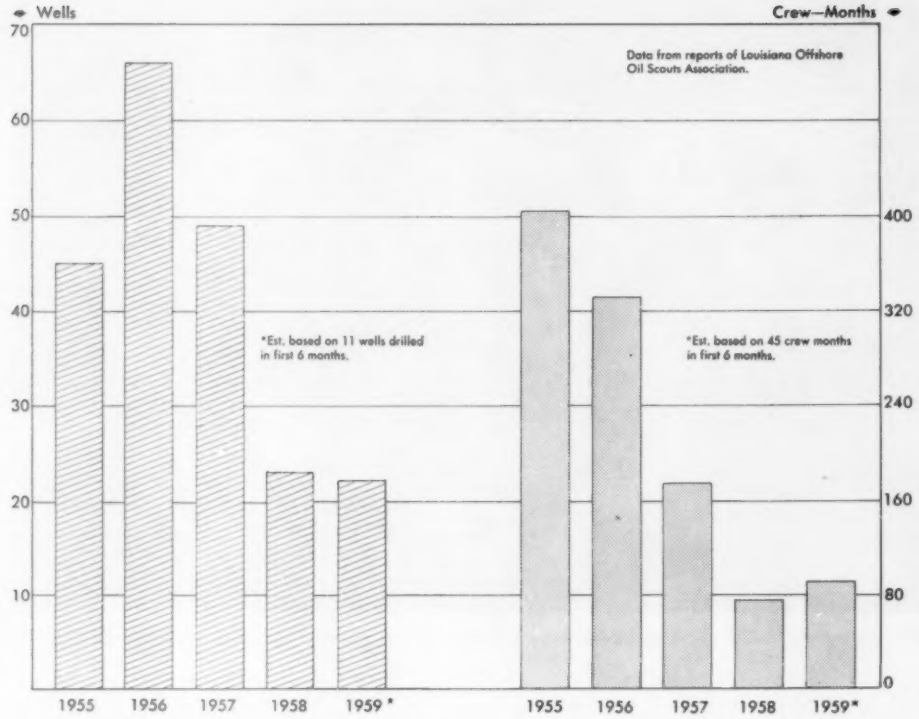


OFFSHORE LOUISIANA exploratory decline is shown in trend of wildcat drilling at left and geophysical activity at right. Fig. 6.

facilities are only about one-fifth depreciated.

Sinking-fund payments. Since the borrowed capital of the pipelines averages about 60 to 70% of the total capitalization of those lines, the 3% annual depreciation rate is roughly equivalent to 5% of the borrowed capital and therefore is usually adequate to retire the bonds over a normal retirement period of 20 years.

That works very well if the pipeline continues to have an adequate supply of gas. However, a large part of the pipeline bond indentures provide for acceleration of the sinking-fund payments whenever, on the basis of an independent engineering study, it appears that the pipeline will not have sufficient gas supplies for a full-line load for the remaining period of the bond payment.

The fact that no such acceleration of such sinking-fund payments has occurred in the past offers litttle comfort to distributors and consumers or to investors in the pipelines. Some of the big pipelines started out a number of years ago with proved contracted supplies adequate to provide a full-line load for as short a time as 10 to 12 years. This was reasonable enough at that time.

Then, the national life index was high, there were large productive areas still unconnected, and exploration and development by the oil and gas industry in the United States were going forward at an ever-increasing rate. There was therefore at that time every reason to suppose that adequate supplies of gas would become available, even though the supplies then contracted were not sufficient. That assurance could continue only so long as the rate of exploration continued to keep up with the ever-increasing demand.

Now we have a different situation. There is no large producing area in which there is only one pipeline purchasing gas. The whole United States is in a situation comparable to several straws drawing out of one bottle. What affects one pipeline's supply affects all.

Prospects for future financing. Consider what the situation will be if the downward trend of finding reflected by these charts is not reversed in the near future. As Fig. 3 shows, if the national demand and production rate continue to increase, as the American Gas Association estimates, but if, on the average, we find each year only the volume of gas that we produce that year, the breaking point or time when we can no longer supply the national demand will arrive by 1973.

The AGA's estimated demand assumes that, every year, there will be increased installation of and financing of new facilities in tremendous amounts. Imagine financing any big amount of new facilities in 1965, 1966, or 1967 when the time when we could no longer meet the required production rate would arrive in 1973.

Now, take one step further and consider what would happen if the national demand should increase as the AGA estimates but we should fail to find on the average each year a volume equal to the volume produced that year. The time when we could no longer meet the required production rate would be much closer than 1973.

However, long before the time arrives when we can no longer meet the required production rate and the pipelines will no longer have a full-line load, the required engineering studies of future deliverability will have triggered the acceleration clauses in the bond indentures, and the pipelines will have to be allowed higher depreciation rates.

An ounce of prevention. On the other hand, if an adequate incentive is provided to the industry to continue its search for gas so that the period of full-line load for all of the pipelines can continue to be extended, the pipelines can continue to operate at high efficiency and low unit costs. It seems to us that an ounce of prevention is worth a pound of cure, and that it would be far better to pay a somewhat higher price for gas in the field and get the needed supplies than to precipitate increased pipeline and distribution costs without getting the gas.

In the Phillips rate hearing, we were charged with predicting gloom and doom for the pipelines, distributors, and consumers. We did not make such predictions and are not making them now. We are confident that, with an adequate incentive, in the way of wellhead gas prices, sufficient exploration will take place and sufficient reserves will be provided to meet the increasing demand for some time.

COMPRESSOR BUILDING, equipment building, and utility building are shown for this compactly designed station.

TGT's Delta-Portland system uses

NEAR THE END of 1959, Tennessee Gas Pipeline Co., a division of Tennessee Gas Transmission Co., placed in service a new pipeline known as the "Delta-Portland line," which included approximately 559 miles of 30-in. pipe and 39,100 hp. The southern terminus is in South Louisiana, Plaquemines Parish, along the shore line south of Port Sulphur and the northern terminus is near Portland, Sumner County, Tennessee.

As shown in Fig. 1 from the southern terminus the line transverses approximately 66 miles of marsh and water crossing to Ansley, Miss., then 493 miles of land and river crossings to the northern terminus, passing through eastern Mississippi, northwestern Alabama, and then to Portland.

The line was designed and tested for a working pressure of 940 psig. Full-opening valves are installed on the main line; plug valves are installed at the proposed compressor - station sites. The valves in the marsh section are provided with automatic valve operators that function on pressure drop versus time since their locations are not readily accessible. The present line will consist of nine compressor stations when completed, and will be composed of eight new locations and an addition to the existing compressor station at Centerville, Tenn.

Station Design

During the past year four of the new compressor stations were constructed and an addition was made to the existing station mentioned above. The new station locations are: Bay St. Louis, Heidelberg, and Columbus, Miss., and Collinwood, Tenn. The design of the new stations is completely different from any used by Tennessee Gas in the past. However, this type of compressor station is not completely new to the industry, as similar design has been used by other companies. In the conception of this design the various problems considered were initial cost, compactness, safety, ease of maintenance, and operational cost. Having satisfied these conditions the design was completed and the stations were constructed.

One of the photos shows the compactness, general arrangement, and location of the buildings. The three buildings, of rigid frame construction with transite covering, are a compressor building, an equipment building, and a utility building. The utility building consists of an office, shop, warehouse, and locker and change room.

The office area has enough space to hold weekly and monthly operational and safety meetings and is provided with all-year air conditioning using natural gas. In addition to the necessary tools and machines, also located in the shop are a combination gas-electric-driven air compressor, a station switchboard, and an emergency generator set.

Piping design. The compressor buildings are provided with space below the operating level to accommodate the installation of the main auxiliary piping in lieu of the large basements that have prevailed in the past. This type of design leaves the operating area open and hazard free. The area below the operating floor is readily accessible because of removable floor plates and grating, and is provided with ample ventilation. The operating floor is supported by a system of floor beams and pipe columns. Insulation was installed underneath the roof of the building to reduce the noise level and to insulate against weather conditions.

The main high-pressure gas piping is installed aboveground on concrete piers. Gas operators were provided on the station suction and discharge side valves and on the station suction and discharge blowdown valves, improving reliability should an emergency occur. Two types of scrubbers have been used, two stations employing inline and two stations horizontal,

UNITIZED DESIGN provides for auxiliaries to be driven by compressor engine.

new station design

BY ROSS O. PARKER, JR.
AND
BEN R. (COTTON) KELLER
Assistant Chief Engineers,
Tennessee Gas Pipeline Co., Division of
Tennessee Gas Transmission Co.

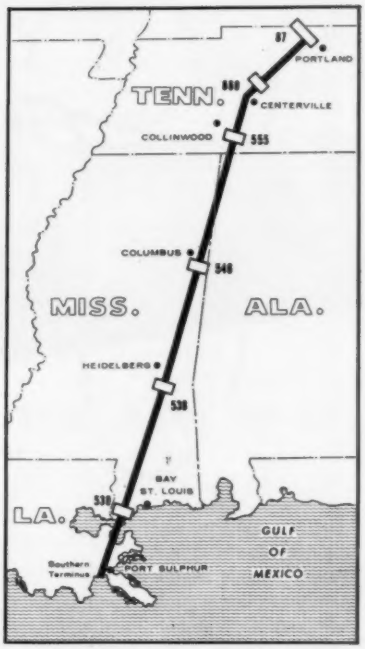
so that operation and efficiency of the units can be evaluated. Each compressor-unit suction, discharge, and by-pass valve is equipped with an electric operator, thereby reducing the time required to start and stop the units.

Metering. In the past all of the station metering equipment has been under cover. It is now an outdoor installation, as seen in a photo. The design is dual regulation, single metering. In addition to the outside localities, each compressor unit has a meter for measuring the fuel gas used. Use of the individual meters aids in the operation of the units and also enables personnel to evaluate efficiency.

Electrical system. Electric - power supply for all the compressor stations is purchased. Since the main compressor units are unitized, no effort was made to improve the continuity of electric service of the existing power-company facilities. Because of the exposure to electrical outages, all of the station controls are pneumatic; natural gas is used as the control medium because of its cleanliness and freedom from moisture.

Where purchased-power failure occurs, electrical energy for valve operators, lights, and other essential functions is furnished by a 35-kw. gas-engine-driven emergency generator. If the purchased power fails, the emergency generator starts and is automatically connected to the emergency section of the switchboard through an automatic transfer switch. On resumption of purchased power the transfer switch returns the switchboard to this preferential source. The generator's prime mover is of the continuous-duty type, and will provide emergency power during any prolonged outage. An exerciser has been included in the emergency-generator control circuit so that the unit automatically starts and runs for 30 minutes each week, assuring availability.

Prime movers. The prime movers or engines are of the angle type, gas fired, and drive reciprocating compressors, jacket-water pump, lube-oil pump, and the hydraulic pump. Each unit is designed to operate individually, dependent only on the station water supply. Although different manufacturers' equipment was used at the four locations, the over-all design and operation are the same.



LINE DELIVERS Gulf Coast gas to main system at Portland, Tenn. Fig. 1.

Cooling system. The engine - jacket water system is designed to be self-contained by units. The jacket-water pump is directly driven by the compressor unit and delivers water to the engine at approximately 150° F. A three-way temperature control valve is located on the discharge of the engine to maintain water from the engine at 160° F. This three-way

valve directs part of the water to the atmospheric jacket-water cooler, where the temperature is dropped to 120° F. and the remaining water is bypassed.

From the three-way valve the water goes through the jacket-water cooler to the lube-oil cooler, then commingles with the remaining 160° F. bypassed water to give an engine jacket-water inlet temperature of approximately 150° F. at the pump suction. From the pump suction the water is circulated through the engine-jacket water system and then back to the three-way heat valve completing the cycle. The fuel gas is heated by bypassing a portion of hot jacket water from the engines; then it returns to the suction of the jacket-water pump, eliminating the freezing of fuel-gas regulators.

The atmospheric cooler fan is hydraulically driven by a hydraulic motor using oil as the medium. The oil is furnished to the motor through a gear pump that is either belt driven or directly connected to the engine.

The fan is designed for variable speed with constant-pitch blades. The variation of the speed is accomplished through a water-temperature controller or thermostat, which will either open or close the bypass at the fan motor depending on the cooling requirements.

The prime movers or compressor units are started, controlled, protected, and stopped through individual engine-control panels. There were two distinct types of engine panels designed and installed to evaluate reliability, maintenance, and ease of operation. One type of panel is a complete pneumatic system. The other type is an electric start-stop, pneumatic control and run.

Incorporated in the panel design is also a manual system for operating so that the controls can be checked and properly adjusted on the initial startup of the new units. The engine starting is automatic up to the point referred to as "idle speed." When an engine reaches idle speed the station operator takes over the control of the unit, increasing its speed by increasing the control pressure to the pneumatic governor through a pressure regulator.

The basic difference in design of the two types of panels is the type of controls used for starting the units and reaching idle speed. The electric start-stop pneumatic-run system uses electric timers to sequence the various operations to idle speed; the complete pneumatic system employs pressure regulators and orifices. The following is a brief description of the electric-pneumatic system.

Safety shutdown devices. Although the starting and normal stopping sequence is controlled through electrical timers, the safety shutdown devices are completely pneumatic so that where purchased-power failure occurs after the unit has been started, the units will continue to operate with full protection.

The shutdown devices are three-way valves actuated by the conditions against which they protect. Actuation of a safety device will operate the safety shutdown three-way valve which in turn will shut off and vent the engine-panel control gas, closing the engine fuel-gas valve. After a short delay, a pneumatic relay closes, grounding the engine magnetos. The engine safety devices are actuated by low lube-oil pressure, low jacket-water pressure, engine overspeed, high jacket-water temperature, high lube-oil temperature, and high exhaust temperature.

With the compressor units at rest the compressor suction and discharge valves are closed, the bypass valve open, and the safety devices in the tripped position. To start a unit the safety devices must be set before the engine start button is actuated.

Startup sequence. When the start button is actuated, an electric timer is closed, starting an air-motor-driven prelube pump, and after 2 minutes

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the timer opens, stopping the pump. During the 2-minute interval or prelube, the compressor discharge valve is opened, admitting gas to the compressors.

When the prelube period is completed, the diaphragm-operated starting-air valve opens, admitting air to the unit. When the starting valve is fully opened an electric timer starts, and at the end of 10 seconds the grounding is removed from the magnetos allowing the ignition system to function. Once the ignition system is operating the engine fuel-gas valves start opening slowly, the unit fires and runs at a speed predetermined by the linkage setting between the governor and the engine throttling valve. Should the engine fail to fire and run after a 45-second cranking period, the starting-air valves and the fuel-gas valves close, and the magnetos are grounded.

When the unit is running at the speed mentioned above, the governor is in the shutoff position, and the lube-oil pressure is allowed to build up to a predetermined pressure. When this pressure is obtained, the engine starting-air valve closes, the shunts are removed from the lube and jacket-water shutdown devices, and 5-psi. control-gas pressure is admitted to the pneumatic governor, increasing the engine speed to idle speed.

After the engine has warmed up, the station operator opens the compressor suction valve to load the engine by actuating a push button. When the suction valve reaches midway in its travel, a limit switch closes and starts the engine bypass valve closing. When the suction valve reaches the full open position, the bypass is closed. The suction valve is electrically interlocked and cannot be opened unless the discharge valve is in the fully open position, preventing accidental operation of the suction valve.

When the bypass valve starts closing, the governor control pressure shifts from the fixed 5-psi. pressure to a variable 3-15-psi. pressure. The station operator then brings the engine up to operating speed with a hand-operated pressure regulator. After the compressor suction valve is open and the bypass valve is closed, electrical power is no longer required for operation of the unit, all functions being pneumatic.

Stopping procedure. The normal stopping procedure of an engine is to decrease the speed and close the compressor suction valve, which in turn opens the bypass valve. Opening the bypass valve returns the pneumatic governor control system to the idle position; then the stop button is manually actuated. When the stop button is actuated, control gas is vented, the fuel-gas valve closes, and the ignition system is grounded. As the unit comes to rest an electric times closes for 2 minutes, starting the air-driven lube pump to dissipate the heat from the pistons and bearings.

The complete station is protected by means of a manually operated shutdown system. Located away from the buildings and yard piping are two emergency stations that are in the areas of egress and ingress by the personnel. By actuating the control station, i.e., opening of a valve, control pressure is admitted into the control line closing the station suction, discharge, and engine fuel-gas header valves, also opening the station suction, discharge, and engine fuel-gas blowdown valves, evacuating the station site of all gas.

Also, the electrical service to the hazardous areas is interrupted. When the emergency system is actuated, fuel gas to the compressor units is immediately vented, stopping the units from fuel-gas starvation, and about 2 minutes is required to completely shutdown and evacuate the station site of all gas.

From data accumulated to date, the design, construction, operation, and maintenance of these types of stations have proved to be reliable and economical.

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163

Commercial Skid-Mounted Plant

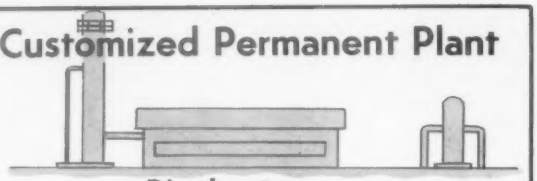
Advantages

1. Low original cost due to standard engineering and economical shop construction.
2. Better portability.
3. Minimum field installation cost.
4. Low cost and completeness of salvage.

Disadvantages

1. Minimal size and competitive quality of equipment, resulting in generally higher over-all glycol consumption.
2. Minimum accessibility for operation and maintenance.
3. High leakage factor due to screw connections in high-pressure and high-temperature glycol lines and equipment.
4. Generally higher fuel consumption due to competitive design for low original cost.
5. High cost of field improvement of original design.

Customized Permanent Plant



Disadvantages

1. High "one-shot" engineering costs.
2. High cost field warehousing of individual components.
3. High "on-plant site" construction costs.
4. High salvage cost.

Advantages

1. Ample sized and desired quality of equipment to improve operation and minimize glycol losses.
2. More spacious design promotes ease of access and maintenance.
3. Maximum use of flange connections to minimize glycol leaks.
4. Lower glycol and fuel operating costs.
5. Tailored design and engineering for each location.

And now . . .

Standardized dehydration plants

• Lone Star is considering stocking a completed skid with an optimum-sized contactor. In a matter of days after an emergency need for a plant develops, the plant can be in operation.

BY F. ZAPFFE
Lone Star Gas Co.

NOW IN SERVICE for Lone Star Gas Co. are two skid-mounted glycol dehydration plants of identical standardized design. This design is applicable to any installation with no additional engineering required beyond the main gas piping to and from the contactor.

The complete plant is designed to combine the best features of skid-mounted and customized permanent plants and to minimize the disadvantages of both. A comparison of the advantages of the skid and the disadvantages of the permanent plant are generally investment cost items, while the disadvantages of the skid and the advantages of the permanent plant are largely operational cost items. This is shown at the top of this page.

The attempt in this design was to minimize investment, while retaining low operating cost, high operating efficiency, and maximum operating convenience.

The plant was standardized to incorporate all features desired by the engineering design group as well as the plant operating group.

The final design evolved was for a 3 g.p.m. plant. This size was found to be more widely suited for Lone Star use. It can adequately handle any contactor size from 36-in. up to 54-in. diameter, depending on gas-flow conditions.

This standardized skid plant is so small and compact that, except for the contactor and high-pressure gas piping, it can be completely contained on one truck trailer. There is adequate space for ease of operation and maintenance, and construction is simple to facilitate relocation when necessary.

The complete plant consists of five units:

1. Regeneration skid.
2. Pump skid.
3. Low-pressure heat exchanger.
4. High-pressure heat exchanger.
5. Contactor and related assemblies.

All units and assemblies, except the bare contactor and the reboiler-still regeneration vessel are built in the Lone Star shop. All material and components are collected by the warehouse adjoining the shop for assembly into a skid unit, or for shipment, with the plant, to the field for field assembly.

All lines except three are aboveground for ease of installation, leak inspection, and schematic tracing. The three underground lines go to the dump pit: (1) a 2-in. dump line from the inlet separator in the contactor, (2) a 3-in. overhead vapor line from

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BRIEF SPECIFICATIONS

Bucket capacity, 2 cu. yd.; bucket reach, 50¾ in. (@ 7 ft. dump height); over-all width (bucket), 93½ in.; wheelbase, 88 in.; speeds, forward (4), 0-24 MPH . . . reverse (4), 0-30 MPH; shipping weight, with diesel engine, 20,780 lb. — with gasoline engine, 20,440 lb.

HIGH LIFT, extra-long reach and safety! Note how bucket lift arms are completely in front of operator's area. This gives him new freedom of movement and greater all-round visibility. Other safety features: wide steps for safe and easy access from either side. Plus wide fenders that provide a handy engine checking platform as well as protection for operator from rocks and mud.

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. . . the Cat wheel-type Traxcavator

. . . the first of a New Wheel Loader Line

DESIGNED FOR ACTION, controls provide instant, finger-tip shifting . . . a full range of work and travel speeds with reverse speeds 25% faster than forward speeds. Travel Range gives 2-wheel drive for roading . . . Work Range automatically puts power to all 4 wheels. Other action features: conveniently located machine and bucket controls . . . forward-reverse lever on the steering column . . . both bucket control levers with kick-out devices. Lift control releases at dumping height — tilt control positions bucket for digging.

DESIGNED FOR PRECISE CONTROL, the No. 944 brake system is outstanding. The left brake neutralizes the transmission as it stops the machine to provide superior loading action. The right brake leaves the transmission engaged for full control when creeping, etc.

VERSATILE IS THE WORD for the Cat No. 944 Traxcavator, which is offered with a full line of attachments and accessories to multiply its usefulness to you on any job. Available are forks, cab (shown here) and special buckets, including the exclusive side dump bucket.

Here's the first of a completely new line of equipment . . . the Cat No. 944 . . . rated at 2 cu. yd. capacity . . . that will soon include the No. 922 (1¼ cu. yd. bucket) and the No. 966 (2¾ cu. yd. bucket).

Watch for these new machines with the bold new design . . . they're ready to bring new standards to wheel loader operation. Take a look at the big new features that make this the easiest and fastest wheel loader to operate. Every feature is designed for *efficient work.* Plenty of horsepower . . . finger-tip steering . . . smooth, fast bucket action . . . outstanding operator comfort and safety.

Choose from two great new engines . . . the compact 4-cylinder Cat D330 Diesel Engine, turbocharged for maximum efficiency . . . or the 6-cylinder gasoline engine. Both are 105* HP units. Whatever your requirements, there's a No. 944 powered to meet your needs. Get the complete facts on the No. 944. See your Caterpillar Dealer the week of March 14. See for yourself how the new design pays off on your loader jobs!

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

*For comparative purposes, the maximum rating of the Caterpillar D330 Diesel Engine used in the No. 944 is 135 horsepower.

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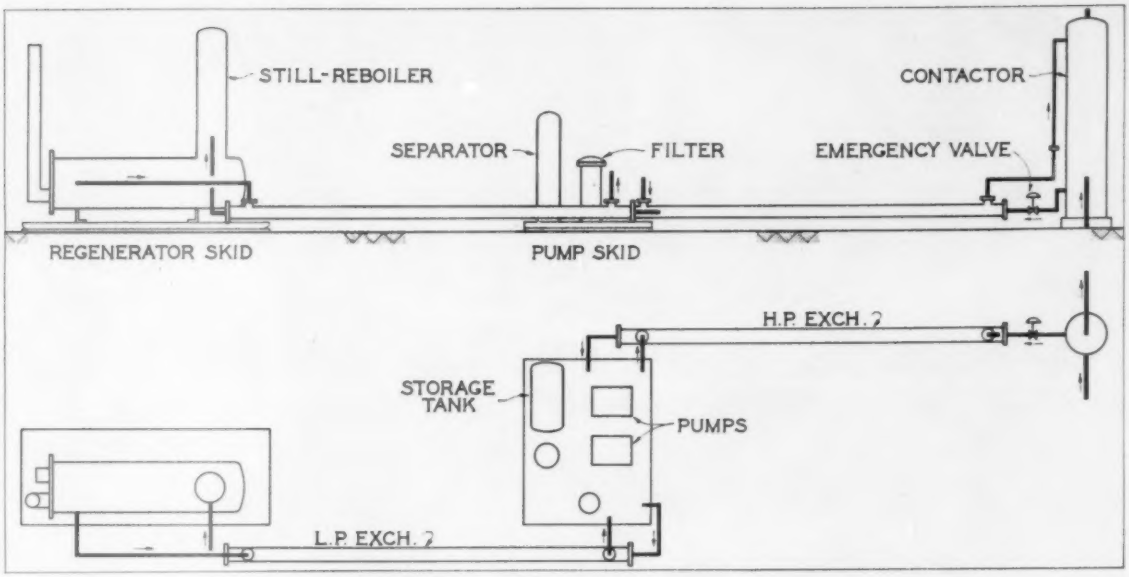
A GREAT NEW PRODUCT IN THE CATERPILLAR TRADITION



STANDARD SKID dehydration-plant layout. Fig. 1.

the still and (3) a 1-in. gas pilot-flare line from the regeneration skid.

The fixed arrangement of the five units are shown in Fig. 1 but the connecting lines between units are not shown in detail. Each unit is connected to the next with two glycol lines, wet and dry, and two gas lines, fuel and emergency control. The total of 16 such connections is fabricated in the shop. Most connections have three directions of freedom, with the shop allowing a few extra inches of length in each direction for field cut and fit, to provide for irregularities in construction and in setting of the units.

The contactor design is universal because there are two inlet gas nozzles at 180° orientation, either one of which can be blind plated so that gas can flow into the vessel from the opposite nozzle. The outlet gas loop from the top center nozzle can be turned in the opposite direction with ease, eliminating any reorientation between contactor and the remainder of the plant.

Thus, the only variation between plants is the manner and direction in which the main gas stream approaches and leaves the contactor. Everything else is standardized and covered in detailed drawings and instructions. Even the variations of contour at each plant site have been considered in the instructions for the installation of the contactor foundation, the two flat slabs for the skids, and the six small blocks for the two exchangers. The site need not be graded flat.

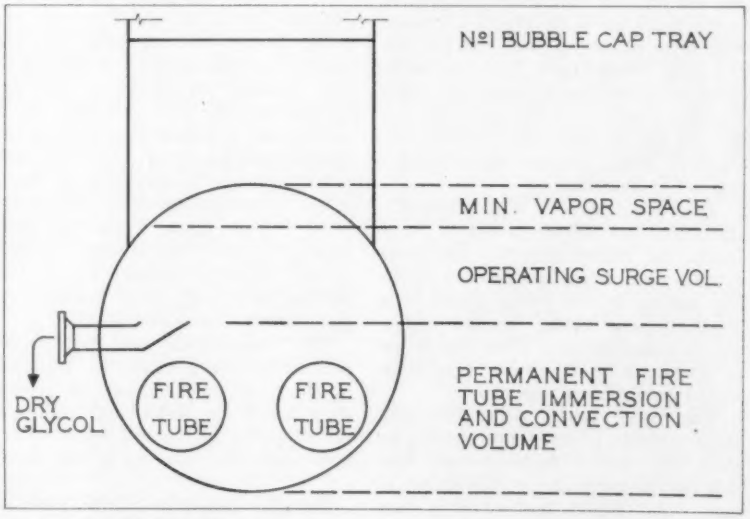
The contactor is shipped directly from the fabricator's shop and set on the prepared foundation. The main gas piping, which has to be engineered specifically for each installation, is field fabricated and tied into the main line. The plant site is fenced, as required; the pit is prepared; and the three underground lines are laid. When the standard plant arrives on one truck trailer, it is set on the slabs and blocks and can be assembled in less than 2 days. A steel tool house is received from the fabricator and set on a pair of concrete runners. The initial glycol charge is loaded into the plant and, generally, less than 5 days after the slabs are hard, the plant can be in operation.

Plant Description

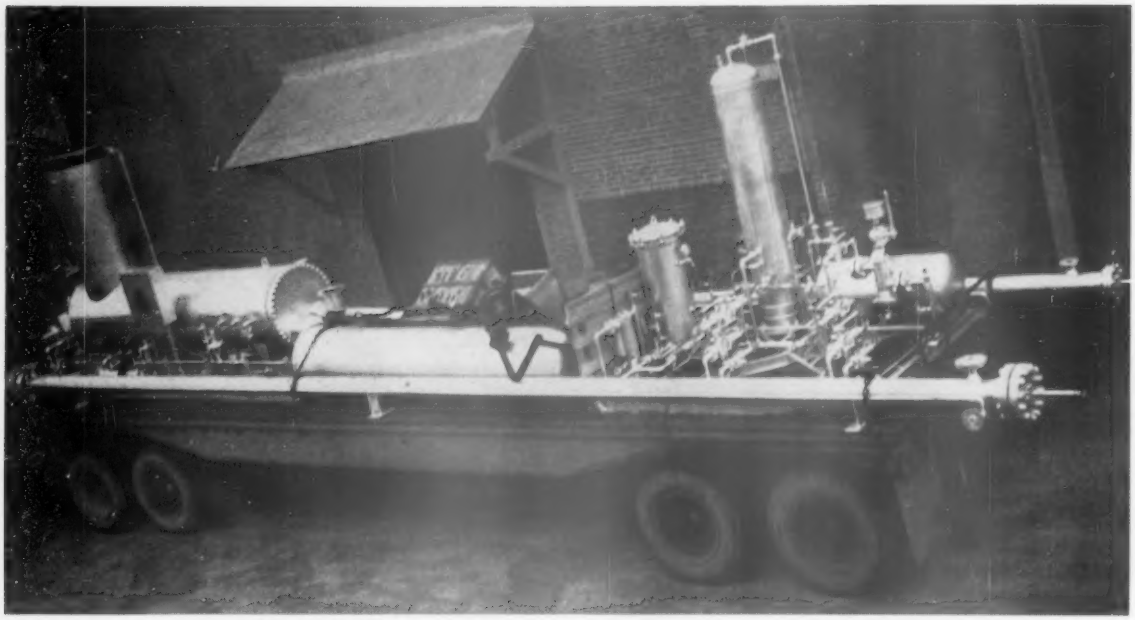
The 5 by 15-ft. regeneration skid supports the reboiler-still vessel with its related fuel and glycol lines.

The vessel is a 30-in. diameter horizontal, direct-fired volume-type glycol reboiler 12 ft. long. Directly mounted on this reboiler at the end opposite from the burner and stack assembly, is a 24-in.-diameter still with 10 bubble-cap trays on 18-in. centers. The wet glycol feeds in on the third tray from the bottom. The lower three trays and the reboiler are insulated, while the top seven trays are uninsulated to provide reflux cooling. The 3-in. vapor-overhead line is carried to the pit where a small pilot light prevents possible damage by igniting any hydrocarbon vapors.

Because the reboiler-still is skid mounted for truck transport, the overall 20-ft. height of the unit must be broken for passage on the highway. This is accomplished by a lightweight



CROSS-SECTION schematic is of regeneration vessel. Fig. 2.



COMPLETE DEHYDRATION PLANT, less contactor, is loaded for shipment.

pair of 24-in. diameter flanges immediately above the feed nozzle and below the fourth tray. This flanged connection also permits the inspection of the third tray, which in corrosive service can be one of the most severely corroded sections in a plant. Standard design calls for stainless-steel bubble caps and carbon steel on all other still and reboiler components.

There is no separate glycol surge tank. The operating surge capacity is included within the reboiler as diagrammed in Fig. 2. The 8-in. return-bend-type fire tube is kept submerged by the position of the outlet flow nozzle. When the outlet nozzle is drained dry, a low-level emergency shutdown trap stops the glycol pumps and shuts off the reboiler fuel to prevent chemical breakdown of the glycol. A plant high-level shutdown trap will prevent the surge volume from filling the minimum required vapor space and thus prevent glycol from being blown out the top of the still, or excessive volumes of liquid distillate from becoming a fire hazard.

This style reboiler was previously developed for larger plants to minimize the recontamination of dried glycol with steam condensing upon the surface of the cooler glycol in a separate surge tank. In the higher glycol concentrations, those few drops of water can be of critical importance to the operation of the plant.

The vessel has a gage glass and three tricocks in the surge portion to skim off heavy hydrocarbons that will not vaporize at reboiler temperature. All liquid hydrocarbons are brought to the still with the glycol. There is a purge-gas distributor pipe at the burner end of the reboiler to help the convection "rolling" of the boiling glycol. There is also a sample connection on the still overhead line to check on glycol loss from the column.

Mounted beside the reboiler on the skid is a temperature recorder-controller with a mercury thermal system. Mounted beside this bulb in the reboiler is an indicating-type temperature controller that is used as an emergency high-temperature cutoff, set about 20° above the recorder setting to take over if the recorder-controller should fail.

Fuel is brought to the regeneration skid from the low-pressure glycol-gas separator on the pump skid. Two control valves, in series to the reboiler burner, are operated by the temperature controllers. A backpressure regulator permits excess fuel gas to spill into the pit. A needle valve around this regulator provides a pilot light to burn pit refuse. The fuel first passes through a drip pot to catch glycol condensation from the separator. The drain from this pot, through a visual flow indicator, passes to the purge-gas connection in the reboiler to handle small volumes of gas and any recovered glycol.

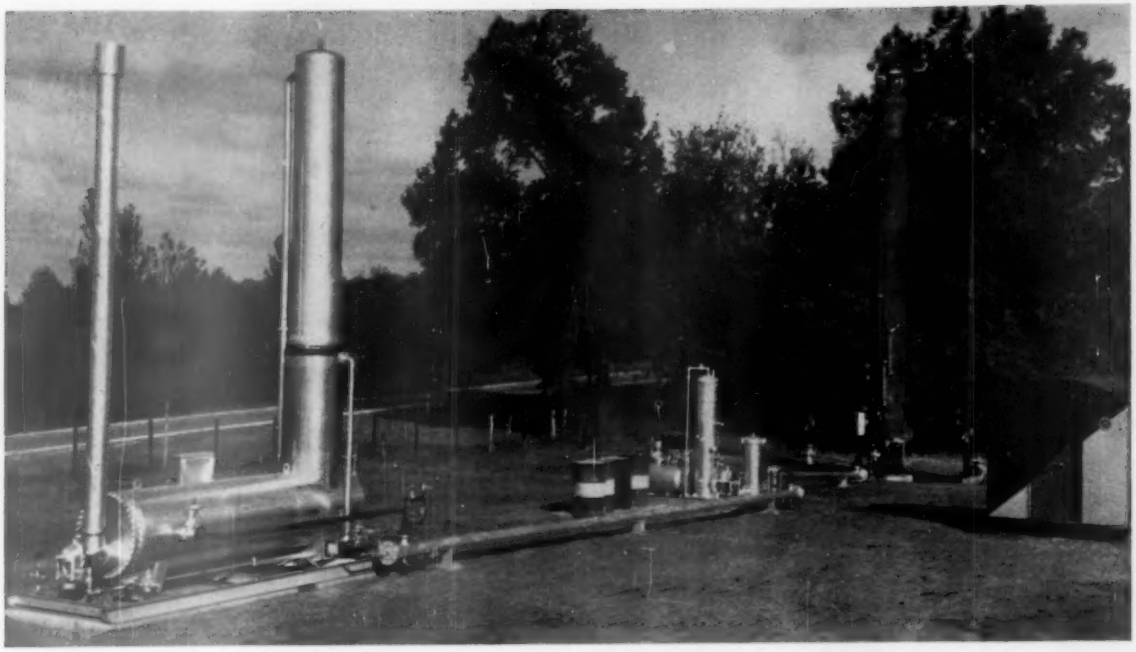
The regeneration skid is shipped with temperature controller installed in the instrument house, all piping shop tested for leaks, and with the reflux section of the still and its overhead vapor line removed in one piece.

Reboiler heat load . . . The reboiler heat load is 375,000 B.t.u. per hour. This is adequate to heat 3 g.p.m. of wet triethylene glycol from 260° F. at the feed tray to 400° F. maximum reboiler temperature and to vaporize: (1) 1.0 lb. of water, and 0.5 lb. of hydrocarbon per minute which the glycol picks up in the contactor and (2) the reflux load in the still column. The total load is almost equally divided between the sensible heat load of the glycol and the vaporization load of the water and hydrocarbon.

The required heat is supplied by the 8-in. pipe-return-bend-style fire tube with a 50-sq.-ft. effective surface area and a design maximum heat transfer rate of 7,500 B.t.u./hr./sq. ft. The burner is limited to a maximum output of 400,000 B.t.u./hr. to minimize decomposition of glycol due to hot spots and high flux rates. This limitation is achieved by holding a maximum burner-tip fuel pressure with a regulator or a pinched valve. The best of reboilers or products can be ruined by overfiring, i.e., by using too high a pressure on the fuel burner tip.

Low-pressure heat exchanger . . . The low-pressure heat-exchanger shell consists of a 40-ft. length of 6-in. standard pipe with 6-in. 150-series welding-neck flanges on each end. The ends are closed by blind flanges containing special seals to permit the 1-in. tube-bundle pipe to enter the center of each blind flange. This allows removal of the flanges from the 1-in. line when pulling the tube bundle.

The tube bundle consists of seven 38-ft. lengths of 1-in. pipe connected in a single-flow path by return bends.



TYPICAL PLANT is shown with field installations as yet unpainted.

Wet glycol enters the exchanger tubing at the pump skid, leaves at the regeneration skid and enters the third tray of the still.

The 6-in. shell has a 2-in. flanged connection at each end on the top center. There is a drain on the bottom of the shell below each 2-in. nozzle. The hot dry glycol enters the shell from the reboiler at 400° F. and leaves at the pump skid at a design temperature of 200° F. maximum to prevent damage to the O-ring seals in the glycol pumps.

The exchanger is mounted on three concrete foundation blocks. Only the center leg is bolted down for stability. Each of the end legs is at the level of the concrete pad under the adjacent skid. Thus, the exchanger will be inclined to conform to the plant-site contour. Even a steep incline will not adversely affect the exchanger operation.

By means of small clips on each side of the 6-in. shell, the 1-in. fuel and ½-in. plant emergency control lines are mounted on the horizontal center, one on each side. These lines are installed, so as to act as supports for half-rounds of insulation that can be mounted on the top half of the shell seasonally to control glycol temperatures.

The four connections at each end of the exchanger are field adjusted to allow for the inclined condition of the exchanger. These connections are sent from the shop in code-identified packages that match the drawings for ease of assembly.

High pressure exchanger . . . The high-pressure exchanger between the pump skid and the contactor is identical to the low-pressure unit except it is equipped with 900-series 6-in. flanges instead of 150-series. The 1-in. flanged drain connections are equally rated. The one at the lower elevation has a drain valve and the higher connection is blind plated. The fuel line on one side of the shell is ½-in. pipe, operating at 100 psig. from makeup regulators on the contactor outlet gas line. The ½-in. emergency control line to the plant shutdown motor valve at the contactor outlet is on the other side of the shell.

The high-pressure exchanger and other components except the contactor are tested to 1,500 psig. or more. Thus, this plant with a suitable contactor can be transferred to high-pressure service without rework.

Pump skid . . . The pump skid is 6 by 9 ft. and contains two glycol pumps, a 16-in. diameter low-pressure separator, a 15-in. diameter sock-type glycol filter, a high-pressure and low-pressure strainer at the inlet headers to the pumps, a 75-gal. dead-storage tank and all necessary manifolds, block valves, fuel and instrument regulators.

The two Kimray Model 9015PV pumps will each pump 90 gal. per hour against 1,500 psig. The design capacity of 180 gal. per hour or 3 g.p.m. was divided into two units to provide for ease of maintenance.

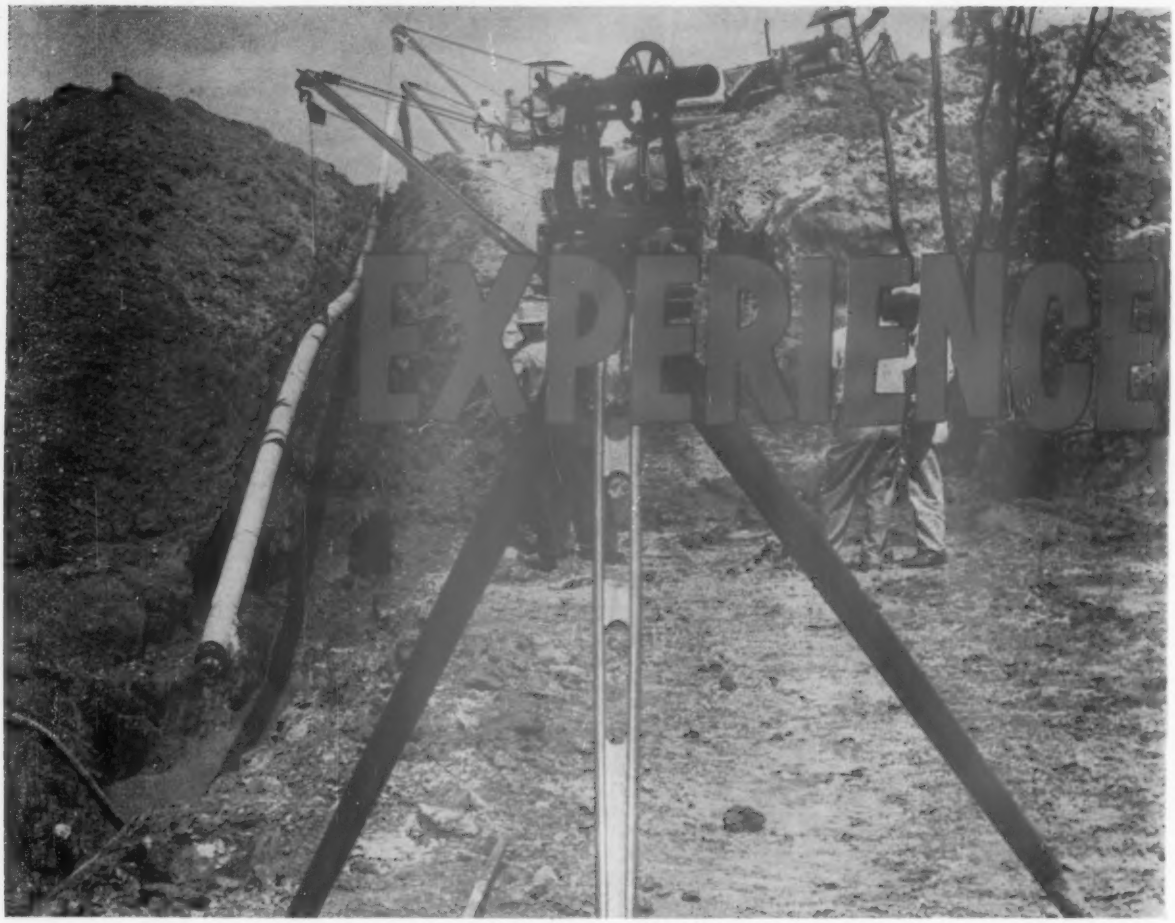
The principle of this type of pump has been explained previously (OGJ, June 2, 1958—p. 102). Essentially, it is a pressure-exchange-type pump that requires only a minimum of supplemental gas for power. Experience has shown that if the glycol-system total pressure drop is held below 10% of the contactor operating pressure, the published gas consumption figures are correct.

For example, at 300 psig. contactor pressure (the minimum pressure at which the pumps will run at rated speed) the gas consumption is 1.7 cu. ft. of free gas per gallon of glycol pumped; at 700 psig., 3.9 cu. ft. per gal. and at 1,200 psig. is 6.7 cu. ft.

Wet glycol, with the volume of free gas indicated, flows from the contactor through the high-pressure heat exchanger, through a Cuno-edge type strainer (0.008-in. plates) to the pumps at a pressure approaching that of the main line. After pumping dry glycol to the contactor, the wet glycol should be permitted to flash to the lowest possible pressure for maximum effective work to be recovered by the pump.

The skid design permits this flashed, wet glycol to enter the vertical separator at about 25 psig. This vessel has a level control to hold a minimum liquid level. At the top of the 6-ft.-long separator shell is a 4-in. pad of 0.006-in.-diameter wire mesh to remove glycol droplets that break out of the foam caused by rapid pressure reduction of the wet glycol.

After passing the mesh mist ex-



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tractor, the separated gas enters the fuel line to the regeneration skid. A makeup fuel regulator near the separator outlet will supply dehydrated gas from the contactor outlet line whenever the separator pressure drops to about 12 psig. This will occur whenever there is a rapid increase in gas flow through the contactor.

This gas surge causes extra volumes of glycol to spill from the trays and thus return a solid stream of glycol without free gas to the pump and separator. This lasts only a few minutes before getting back in balance with the free gas, but the reboiler could consume all the gas in the system if not supplemented. The fuel-consumption balance will be discussed later.

Returning to the liquid-level controller at the bottom of the low-pressure separator, the glycol flows to the inlet of a 15-in.-diameter filter that contains three sock-type cartridges about 5½-in. diameter and 32-in. long. This seemingly oversized filter returns dividends in that the higher viscosity glycol at 100° to 135° F. does not cause excessive pressure drop over the large filter area. Also, changeout is needed less often due to the slower buildup of contamination over the larger surface. An internal relief, set at 35-psi. differential, prevents total inoperation in event of high differentials and only causes a backup in the separator pressure. From the filter outlet, the wet glycol enters the low-pressure heat exchanger.

The flow of dry glycol through the pump skid is from the shell of the low-pressure exchanger through a Cuno strainer, to the pumps, and directly to the shell of the high-pressure exchanger. On all openings of the pumps are block valves and pressure taps to test the efficiency of the pumps. The wet-glycol low-pressure outlet-line block valve should have a very small ½-in. ball check-valve bypass.

If that block valve should be closed before the high-pressure inlet wet-glycol block valve is closed, the full contactor pressure could be against the low-pressure pump connection and valve. The check valve would permit the high pressure to bypass the block valve without excessive pressure buildup. A block valve is necessary so that one pump can be repaired while the other operates even if the line pressure is only 25 to 30 psig.

A clapper-type check valve was tried in lieu of this block valve, but the explosive violence of the high-velocity flashed glycol hammered the check valve until it was necessary to replace it with a block valve and the smaller check-valve bypass.

Near the fuel-makeup regulator is a small instrument-size regulator that supplies 20-psig. pressure through a 1/32-in. orifice to the plant emergency system. So long as the reboiler level is normal, this system remains at 20 psig. If an abnormally low level appears in the reboiler-surge vessel, due to a leak or abnormal carryover from the still or contactor, the low-level trap will permit the 20-psig. system pressure to bleed into the reboiler faster than it can flow through the 1/32-in. inlet orifice.

Failure of this system pressure will cause a motor valve on the wet glycol outlet from the contactor to close and thus stop the flow of glycol and power gas to the pumps. This will stop the flow of glycol to the trouble spot. At the same time, loss of the emergency system pressure will flip a three-way valve in the reboiler fuel line at the regeneration skid, bleeding off the downstream fuel pressure to the burner, and blocking the upstream fuel system so that dry makeup gas will not keep the reboiler fire burning.

An abnormally high reboiler-surge level, caused by excessive hydrocarbon liquids or excessive amounts of makeup glycol, will cause the high-level trap to shut the plant down.

The normal working volume between the high and low traps is adequate to handle the glycol surge from all normal variations in gas flow through the contactors from zero to 100% design volume for vessels up to 54-in. diameter, and at the same time allow an additional operating volume of at least one full drum of glycol for other plant variations or troubles.

To simplify the operation of the plant, a 75-gal. dead-storage tank is provided. This size tank permits the addition of one full drum of new glycol as needed and yet leaves room for slop drainage from the various maintenance operations around the plant. When glycol is needed in the active surge, a supply of gas pressure will blow glycol from the storage tank into the low-pressure separator.

A small concrete slab is provided adjacent to the storage tank to stand three glycol drums up out of the dirt to prevent rusting the lower chime.

Contactor. The 36-in.-i.d., 1,200-psig. working pressure contactor used in the standard skid design contains all features employed in larger contactors. The major points conducive to good operation and maintenance are:

1. An internal inlet separator complete with a fine wire mesh mist extractor to remove maximum quantities of liquids entering with the gas.

2. A glycol sump tray to contain the maximum anticipated volume of glycol that can accumulate in the vessel. This prevents loss of glycol into the inlet separator for possible loss into the pilot light at the pit.

3. Eight trays on 24-in. spacing. Each tray contains nearly the maximum number of bubble caps to permit the largest possible gas surge with minimum blasting of glycol from the trays. Such liberal use of bubble caps permits safe utilization of design gas volumes at below design operating pressures, and even permits volumes much greater than allowed by conventional design for the same vessel diameter.

The eight trays help maintain desired dew-point depression when the inlet-gas temperature is at winter ground temperature at pipeline depth (45° F. at 3-ft. depth in Texas). Also, this large number of trays provides the additional gas-glycol contact necessary for the very high glycol viscosity at such temperature and thus produces dew points well below 0° F.

4. Another removable fine-wire-mesh mist extractor above the top tray to stop glycol mist. The total glycol loss of this type of plant, including leakage and cleanout losses, is below 0.35 lb. of glycol per M.M.s.c.f. of gas processed.

5. Total internal accessibility by means of two external manways, top and bottom, and internal manways on each tray. This permits routine maintenance inspection for operational difficulties as well as for corrosion. This cannot be accomplished in a vessel smaller than 36-in.

6. An external ladder, safety cage, and platform for access to sample taps on each tray, the top manway, and the relief valve on the top head.

The design of this contactor has been standardized, thus eliminating the review of the fabricator's prints each time a new vessel is built. The fabricator delivers the vessel directly to the plant site to coordinate with the brief field construction period.

Except for the major size gas piping, all small piping at the contactor is prefabricated in the Lone Star shop to fit into brackets and clips installed on the vessel by the fabricator. For example, the glycol meter and house is mounted on the side of the contactor adjacent to the orifice flange. Fuel lines, control lines, and related small piping are supported from the vessel. The 2-in. dry-glycol line to the top tray is bracket-supported from the vessel by threadolets welded to the vessel shell.

Dry makeup fuel is taken from the outlet-gas line by means of two antifreeze instrument-size regulators. The second regulator is for standby and for possibly required momentary extra capacity. These regulators have their

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throttling valve located in the center of the main gas stream and thus will not freeze in the single cut from as high as 1,500 psig. to the 100 psig. used as supply gas to the fuel-makeup regulator on the pump skid.

Fuel balance. When the plant is operating at the rate of 3 gal. of glycol per 1 lb. of water removed from the gas stream and the contactor pressure is between 600 and 800 psig., the fuel consumption of the reboiler, plus a minimum pilot light in the flare pit, will balance the volume of power gas required by the Kimray pumps. As shown in the previously mentioned power - gas - consumption figures, waste-flare gas will increase at higher operating pressures, and conversely, at lower operating pressures, small amounts of dry makeup fuel gas may be needed.

Thus, a balance of operation can be effected between the pump and reboiler operation. A show of excessive amounts of flare gas can possibly indicate that more glycol is being circulated than may be needed. At the other extreme, to minimize the use of dry makeup gas, perhaps the pumping rate could be increased to gain the maximum glycol-water extraction rate for a better dew-point depression.

This plant design makes possible, within the scope of operational control, an optimum balance between plant performance and fuel economy.

Summary

A standard design skid unit has been described which, when used in conjunction with an appropriate contactor, at line pressures from 300 to 1,500 psig., is universally suitable for removing 1,440 lb. of water, plus related hydrocarbons, per day from a gas stream.

Excesses in sizing, capacity, and working pressure of individual components are justified in that:

1. The differential cost between a given minimal item and the standardized item would possibly not pay for the added design and construction costs to custom buikd each plant from individual specifications.

2. Operational savings in glycol consumption and reboiler fuel can pay out the additional investment in 3 to 4 years.

3. The intangible operation, maintenance, and capacity advantages will reflect their payout in less concrete but yet positive manner.

Thus for standard units that can possibly be moved several times in their anticipated 20 or more years of operation, the indicated excesses can be paid out several times in their operating life.

BY W. L. NELSON
Technical Editor and
Petroleum Consultant

Soaking factor applied to viscosity breaking

The discussion of soaking factor on page 674 of your Petroleum Refinery Engineering indicates that it applies only to vapors. Can it be applied to viscosity breaking when much of the material is a liquid? Also, where is a reference that discusses the derivation of soaking factor and the meaning of the various therms? H.C.O.

The soaking-factor method was derived jointly during World War II by the staffs of several oil companies and contractors, and it has not been discussed in the literature. It was distributed as a "restricted" paper and this department has never been able to locate a copy of the original paper.

The mathematical derivation of soaking factor (Equation 19-24) shown in the Fourth Edition of Petroleum Refinery Engineering (McGraw-Hill Book Co., N. Y., 1958) on page 675 is thought to be a valid derivation and it is derived for gases. It necessarily involves a Z factor to care for deviations (from ideal) in the behavior of gases at high temperatures and pressures.

Thus, theoretically the soaking factor cannot be used for liquids or mixtures of liquids and gases as in viscosity breaking. However, if experimental tests are made at the same pressure as the pressure that will be encountered commercially, we believe that the deviation from ideal behavior will be about the same in both instances and thus the soaking factors obtained in the laboratory will be substantially the same as those encountered commercially (at the same pressure).

This brings us to the fact that several companies seem to have used the soaking-factor equation for any conditions, that is, viscosity breaking, low pressures, high pressures, etc. Such a usage results in numerical values of the soaking factor which may not describe the behavior of the system as accurately as when the limitations of the method (i.e., gaseous state, pressure of 750 psig., etc.) are adhered to, but these empirical numerical values do nevertheless introduce such major variables as temperature and time. It must also be recognized that soaking factors are always empirical, that practical numerical values of soaking factor can be obtained only by experimental or commercial test runs. There is no mathematical way to predict what the maximum yields can be or at what limit coke formation will halt the cracking process.

In summary, the soaking-factor method of comparing cracking yields under various conditions of time, pressure, temperature, etc., applies only to gaseous systems. Values of the soaking factor must be obtained by experimental tests for each system or from such scant information as that given in Petroleum Refinery Engineering. It may be used with fair accuracy for systems in which the material is partly liquid (viscosity breaking is an example) if the numerical value of the soaking factor was obtained from experiments conducted at the same pressure as the proposed commercial operation and in the same general range of temperature.

The relative reaction velocities shown in Table 19-18 of Petroleum Refinery Engineering are the ratios of the reaction velocity constants each divided by RT (T is absolute temperature).

How to describe refining complexity

Have you any way to describe the complexity of a refinery operation perhaps like the "relative handling" you use in your Process Costimating No. 11 on Steam and Fuel Requirements? F. G. C.

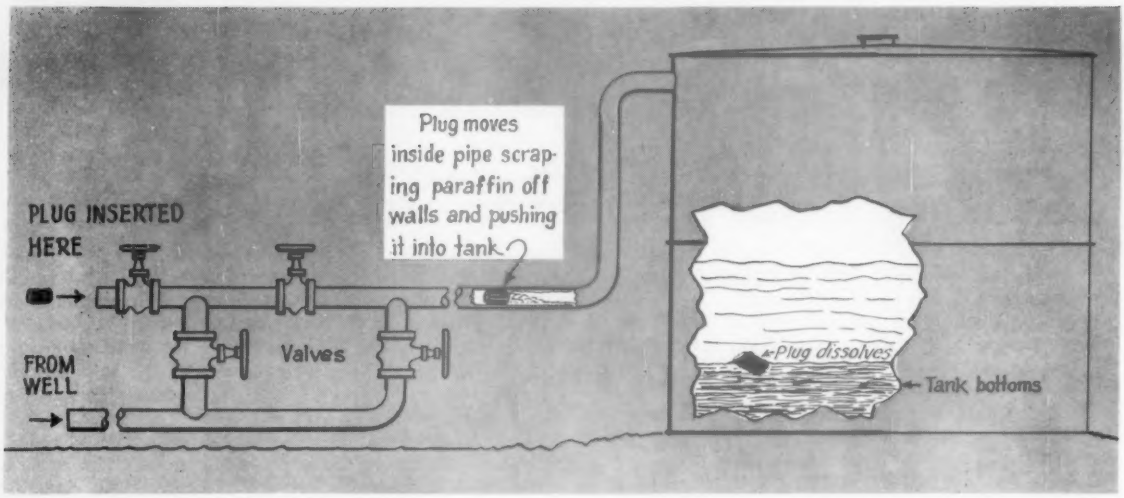
Since publishing Process Costimating No. 11 (and No. 12), a somewhat better method of determining complexity has been devised. It consists of weighting each process operation as compared with topping or crude distillation as indicated in the following tabulation:

This refinery operation would be about 6.6 times more complex than crude distillation.

In the tabulation, the first column indicates the capacity of the various process units relative to that of crude oil and the multipliers are simple weighting factors to introduce the general complexity of the various processes. Auxiliary utilities were included with each of the processes (except crude topping) and this is the reason that the weightings shown here may appear to be large.

WEIGHTING COMPLEXITY OF REFINERY OPERATIONS

	Capacity, %		Weight	
Crude topping	100	X	1	=100
Thermal cracking	22	X	3	= 66
Thermal reforming	4.2	X	3	= 12.6
Viscosity breaking	4.8	X	2	= 9.6
Coking	4	X	8	= 32
Catalytic cracking	46.3	X	4	=185.2
Catalytic reforming	13.1	X	3	= 39.3
Polymerization	1.7	X	4	= 6.8
Alkylation	3.3	X	8	= 26.4
Hydrogen treating	6.8	X	4	= 27.2
Vacuum flashing	none		1	—
Vacuum distillation	25.9	X	4	=103.6
Lube manufacture and specialties	none		50	—
Asphalt	none		2	—
Light oil treating	48	X	1	= 48
Naphthenic lubes and specialties	none		20	—
				656.7



PARAFFIN PLUG, inserted into flow line through a simple trap, moves along the pipe and pushes accumulated paraffin into the storage tank.

Peewee pigs remove flowline paraffin

BY W. B. BLEAKLEY
Production Editor

HIGH COSTS and low profits mean that every barrel of oil a well will make is important. Collections of paraffin in the tubing and flowlines can reduce a well's output, resulting in less profit. Periodic line-cleanout means increased cost unless some inexpensive method can be used.

Simple solution. The problem of paraffin removal in flowlines is easily solved by using miniature pigs, that accomplish the same results that their larger counterparts do in large-diameter pipelines. The big difference is that these miniatures are made of paraffin.

This sounds like "fighting fire with fire," but it works.

Called Para Plugs, these paraffin cylinders are made by William H. Mason Co., Tulsa, under license from Pan American Petroleum Corp. They are available in several sizes to fit standard pipe from 1-in. to 4-in. diameters.

The plug is inserted in a simple trap that can be made in the field, and is forced along the pipe by the pressure of the oil behind it. As the plug moves forward in the pipe, paraffin is scraped from the pipe walls, and is forced ahead of the plug.

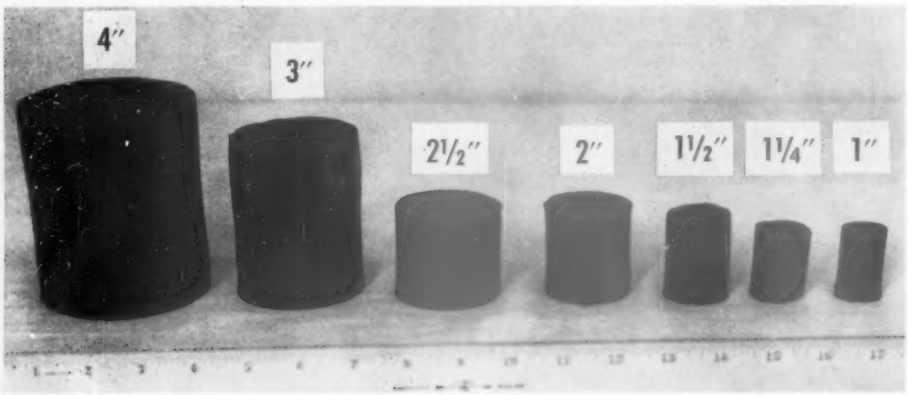
There is no problem in retrieving the plug, because it falls into the storage tank and dissolves, eventually becoming part of the tank bottoms.

Being made of paraffin, the plugs are semirigid, and can easily pass through any valves and fittings that are in the line. If there is any unusual obstruction in the line, a piece of metal or the like, the plug will deform enough to clear the obstruction, and permanent line blocking is avoided.

Use in wells. These plugs can also be used to remove the paraffin from tubing. This requires additional equipment, but nothing that isn't usually available.

The plug is lubricated into the wellhead, and a pump is used to force lease crude into the tubing, against well pressure. The plug is pumped to the bottom of the tubing, and any paraffin in the tubing is scraped off, falling to the bottom of the well. When the well is put back on production, this accumulated paraffin is produced in a slug, and ends up in the tank bottoms.

Low cost. These paraffin plugs represent a cost-saving method of cleaning out flow lines. For example, a 2-in. line can be cleaned for about 50 cents.



PARA PLUGS are available in a variety of sizes as shown to accommodate all standard pipe.

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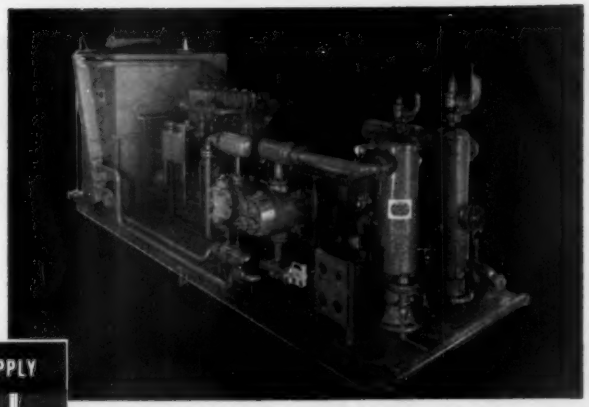

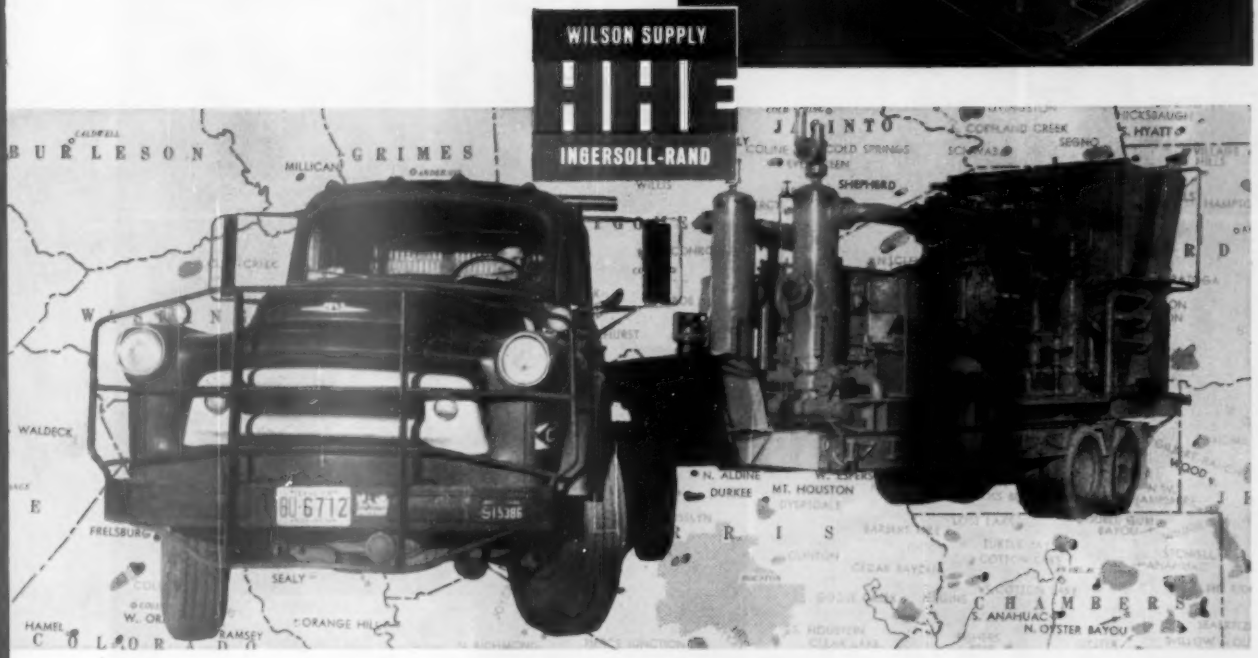

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The HHE unit is becoming the favorite in the field, and currently units are handling a variety of field applications in Oklahoma, Kansas, New Mexico and Texas.

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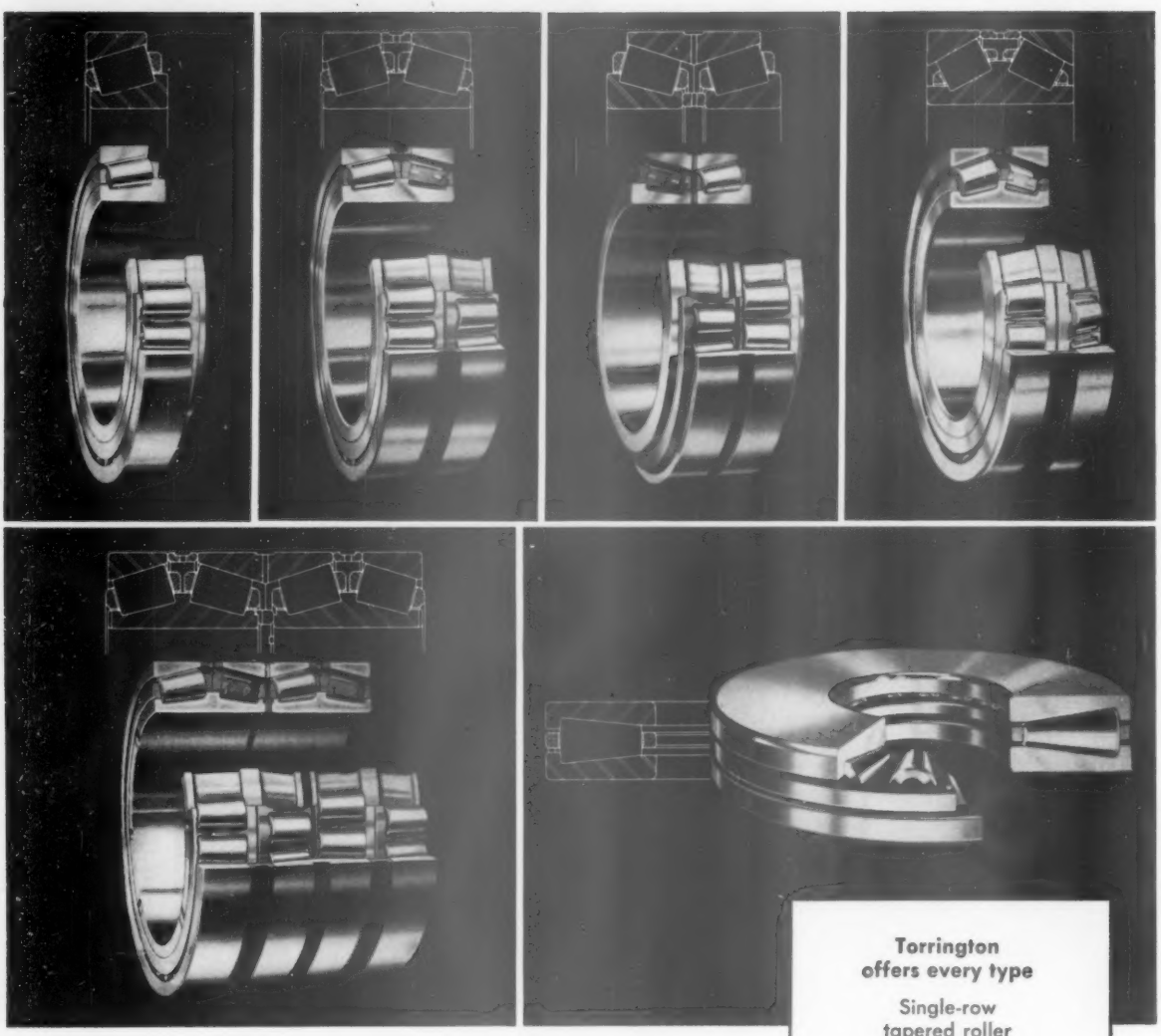

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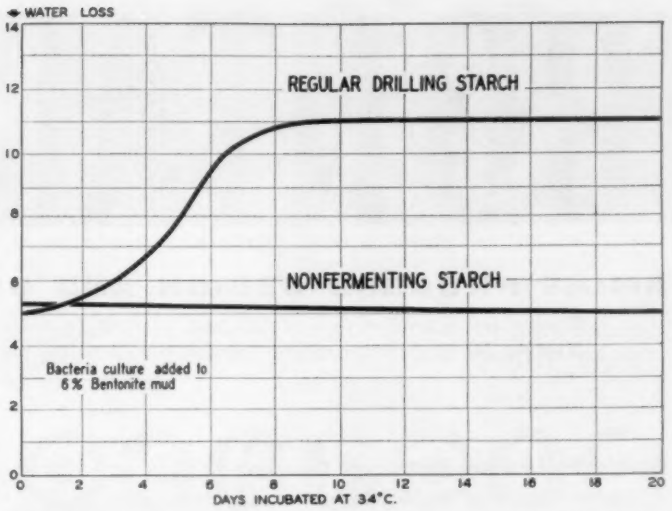
New nonfermenting starch makes low-water-loss muds cheaper



NONFERMENTING STARCH shows low water loss over 20-day incubation period. Regular drilling starch shows increasing water loss for the first 8 days. Fig. 1.

BY WILLIAM H. ASHLEY
President, President Laboratories, Inc., Laurel, Miss.

WATER-LOSS in low-pH muds can now be controlled more inexpensively. The thing that makes this possible is a new starch material which will not ferment in use.

In many cases, the nonfermenting starch costs only 70% as much to use as conventional starch and its companion preservatives. This new material has been extensively tested in the laboratory and in widely scattered wells in Mississippi, Alabama, Florida, and South Louisiana. And, the bacteriostatic starch was completely satisfactory in every case.

The means used to prevent fermenting* is to coat each individual particle with a preservative. Thus, the starch itself is rendered bacteriostatic. The old method requires the entire mud system to be treated with a great volume of preservative.

To make the new mud material, starch in its refined or unrefined form is mixed before packaging with a 75% ortho-benzyl-para-chloro-phenol solution. The OBPCP is insoluble in water, so isopropyl alcohol is used as a solvent. The solution is precalculated to deposit 2.5% by weight of OBPCP on the starch.

The preservative is attached to each starch particle by adsorption and the alcohol solvent is evaporated away. Since the OBPCP coating is insoluble in water, the starch becomes permanently protected from bacterial attack in muds which are, of course, water-based.

Starch has long been used with great economy as a water-loss-control agent in lime and salt muds. The problem came in low-pH (below 11.5) muds where ordinary starch is readily fermented by soil bacteria. Such muds must be rendered bacteriostatic by adding such preservatives as formaldehyde. These preservatives are expensive and have other drawbacks. As a result, a bacteriostatic starch has long been discussed in the drilling industry.

Now such a starch has been developed. It can be used in any mud without controls to prevent fermentation; and further, laboratory tests show it to be the equal of starches now being used in the high-pH, salt, and preservative muds.

Laboratory tests. The bacteriostatic condition of Prescose was described in great detail by Dr. William Owen and William A. Romans. Owen and Romans also presented two methods of testing the fermentation resistance properties of starch, one using Taka Diatase inoculation, and the other using normal bacterial cultures taken from field drilling muds.

Fig. 1 represents the Taka Diatase inoculated mud, the Diatase being the amyolytic enzymes secreted by the microorganisms known to induce severe and rapid starch fermentation. This procedure is actually too extreme to be representative of fermentation as it occurs in drilling muds, but it expresses the superiority of the new material in low-pH mud compared to regular starch in the preservative-type mud.

Field Tests

Widely separated locations in Mississippi, Alabama, Florida, and South Louisiana were selected to test the actions of the different soil bacteria strains of the areas against the bacteriostatic condition of the nonfermenting starch. This nonfermentable characteristic was of primary importance since the economy of starch has long been established. Consequently, the economics presented may not be completely representative of the potential savings.

An example of savings from a single treatment might be as follows. Suppose a 1,500-bbl. system of a 9-pH mud requires 10 sacks of starch. Cost of the 10 sacks of nonfermenting starch would be $125. Ten sacks of regular starch ($80) plus 150 lb. of preservative ($90) would cost $170. Savings of the nonfermenting material is $55.

Baxterville, Mississippi. Six wells were drilled in this field using low-pH fresh-water muds treated with Prescose to maintain water loss between 6 to 8 cc. from 7,000 to 10,000 ft., total depth. Viscosity was maintained at 40 seconds and weight at 9.6-10.0 lb. per gal. Prescose was used for approximately 14 days' drilling time plus 7 days' completion time without fermentation.

Cost of the Prescose muds averaged $3,000 while the field average for normal low-pH muds is also $3,000. Drilling time for these wells was the same as for those which did not use Prescose.

Pistol Ridge, Mississippi. One 11,000-ft. well was drilled in this field using Prescose in a low-pH fresh-water mud. No fermentation occurred. Drilling rate was normal, and the cost of the mud was average for the area.

*Patent No. 2908597 issued October 13, 1959, to Dr. William Owen. Marketed under the name Prescose, trade-mark registered.

CONTACTOR

AMINE PROCESS DESIGN AND OPERATING INFORMATION

Proper use of amines in well designed, correctly operated equipment is essential for efficient gas treating. Some of these important design and operating considerations will be discussed in this series.

Basic Rules for Reboiler Design

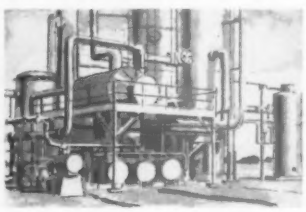
Since the reboiler is the hottest point in a system, maximum efficiency is possible only if these basic design principles are followed:

1. Two or more inlet and outlet nozzles should be employed. This prevents dead flow areas which promote corrosion.

2. Reboilers that operate liquid full are generally superior. They help prevent concentration of higher-boiling corrosive compounds in the reboiler.

3. Tube vibration should be prevented if possible. Condensate should be drained from tubes, long unsupported tube spans eliminated, and teflon inserts used to prevent baffle cutting.

4. Hot oil or direct fired reboilers should be avoided if possible. If they are used, it is mandatory to achieve high circulation rates on the amine side to prevent tube hot spots.



Solution Pressure Reduction

The care used in selecting the proper point for reducing pressure of amine solutions will pay dividends in long equipment life. It is always desirable to maintain pressure on the rich solution until after heat is interchanged with lean amine.

Since high pressure heat exchangers are quite expensive, other methods can be used for reducing point of pressure. For example: use a rich amine flash tank prior to interchange, follow by interchange at about 250-300 psig., and then reduce to still pressure. The flash gas (usable as auxiliary fuel) contains almost all of the dissolved hydrocarbons and little acid gas.

Valves for reducing rich amine solutions are subject to an abnormally high corrosion rate. *Stellite* works well for this service when used in conjunction with high stainless alloy body (316 or better). The valve should have large flow chambers and the inner valve should be as large as practicable.

Fluid Velocities

A fortunate property of ethanolamines is that they are mild corrosion inhibitors. They are also excellent film formers . . . but once formed, the film is not tenacious. An additional measure of corrosion inhibition is obtained in systems absorbing H_2S from a thick FeS layer that passivates the surfaces on which it is formed. High fluid velocities should be avoided at all costs since they destroy these forms of protection.

Avoidance of stream impingement onto tubes in heat exchangers is especially critical in rich amine streams.

Because diaphragm control valves are expensive, small valves are sometimes employed for solution pressure letdowns by swaging the line to fit them. This basically is *not* good practice, since valve and swage corrosion generally occur.

Minimizing Stress Corrosion Cracking

Since ethanolamines are likely to cause stress corrosion cracking, vessels and piping should be stress relieved after fabrication and welding on oil equipment. Care should be taken in erection of stress relieved equipment to prevent setting up mechanical or heat stresses.

Cases have been reported where columns had to be replaced after only 2-3 years operation because of stress corrosion cracking. In addition to stress relieving, stress corrosion cracking can be minimized by controlling process conditions, since cracking occurs only in a corrosive environment.

FOR MORE INFORMATION, look for future issues of Allied Chemical Contactor featuring articles on ethanolamines and glycols in gas treating operations.

We will gladly send technical data, delivery and price information on Allied Chemical Ethanolamines and Ethylene Glycols.

For specifications and local offices, see our insert in Chemical Materials Catalog, pages 475-482 and in Chemical Week Buyers Guide, pages 37-44.

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Citronelle, Alabama. Eight wells were drilled in this area using Prescose as the filtrate-control agent from the anhydrite at 10,400 ft. to total depth of 11,600 ft. Average mud cost with Prescose was $3,000 (field mud costs are considered normal in a range from $2,800 to $4,000 per well.) No fermentation occurred in these wells, and the penetration rates were considered normal even though one well set a new field record.

Gwinville field Unit A. Unit A in this field encountered many difficulties. A low-pH Prescose mud was used to approximately 11,500 ft. without any difficulty. At 11,500 ft. (with surface pipe set at approximately 2,000 ft.) the mud was converted to a gypsum-base mud. Immediately the hole began heaving shale from a section at 4,500 ft. The shale continued to slough until the well reached 13,600 ft., total depth.

During the troublesome interval, Prescose, sodium-carboxy-methyl-cellulose, and ligno-sulfonates were used to hold the water loss under 6.0 cc. However, the increased solids from the shale continued to hamper the viscosity control. Great amounts of water were used, which, in turn, caused even higher additions of costly mud additives.

Final cost of the mud used on this well has not yet been tabulated since, while setting casing at 13,600 ft., some 10,000 ft. of cement prematurely hardened. An additional 30 days were required to drill the cement from the casing.

Water was used to drill the cement, and the gyp mud was saved for completion operations. Although the mud cost was higher than the field average and the drilling rates slower due to the time lost in circulating out the shale, these poor features were not a reflection of the Prescose quality.

Gwinville field Unit B. As a follow-up to the well above, another well was drilled in this field using the nonfermenting starch as the basic filtrate-reducing agent. This particular well was drilled to a total depth of 14,500 ft. using a low-pH fresh-water mud. The chemical dispersant used was ferro-chrome-ligno-sulfonate.

Massive anhydrite was drilled at 12,800 ft. and stringers of additional anhydrite were encountered from this depth to 13,850 ft. With such anhydrite stringers it would be natural to expect increased mud cost and control problems. On the contrary, this mud program withstood the added contamination and actually set a record for this field.

The mud properties remained constant with water loss of 5 to 6 cc. and viscosity was easily controlled at 50 to 52 seconds. The following records set by the rig on this well compliment the mud more than any statements that could be made.

First, this was the only well drilled to date with a trouble-free hole. Second, this well established a new penetration rate and bit record. Cost of the mud was the lowest in the field to contract depth of 13,400 ft., being only $8,290; more important, excellent mud properties were maintained at this low cost.

Cost of the Prescose low-pH mud to total depth of 14,500 ft. was $18,000. The offset well using a different filtrate control had a $28,000 mud bill to the same depth.

Martinville, Mississippi. Two wells using Prescose muds were drilled in this field. Well A was drilled to 14,000 ft. using a conventional low-pH oil-emulsion mud. Seven-inch casing was set at 14,000 ft. and the well carried to 14,767 ft. using Prescose to control the water loss under 6.0 cc.

Drilling time from casing at 14,000 to 14,767 ft. was 24 days followed by 35 days' completion time. Although bottom-hole temperature was 320° F., filtrate-control cost was only about $28 per day. This cost is quite low considering depths, temperatures, and the time elapsed. Mud properties during this interval were: viscosity 50-52

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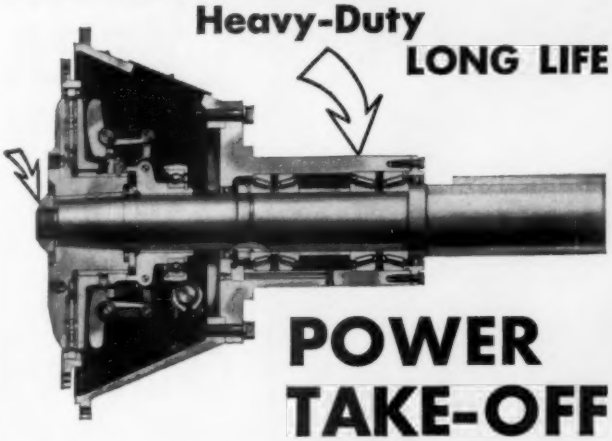

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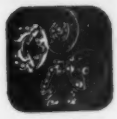
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CLUTCHES

seconds, weight 10.2-10.4 lb. per gal., gels 0-0, water loss 4-6 cc., oil 7%, pH 8.5-9.0, salt 1,400 p.p.m.

Well B was drilled to the salt at 15,124 ft. using a fresh-water Prescose low-pH mud. The hole was 9⅞ in. in diameter with 10¾-in. surface casing set at 2,500 ft. This well was the only one in the field to drill to the salt with only surface casing set.

Two direct offset wells were drilled to 13,900 ft. using cellulose and acrylate filtrate-control agents. Since these offset wells, C and D, used the same bit and mud programs, a comparison can be drawn between them and well B at a depth of 13,900 ft.

Differences in mud costs would have been even greater on well B had not one of the rig's three motors failed below 13,000 ft. During this 4-week interval, the rig continued to drill using only two motors. Drilling rate was reduced by this power loss, and mud could not be mixed or stirred properly; hydraulics were poor.

In spite of these adversities, the Prescose-treated mud had relatively low cost to 13,900 ft. Mud costs of offset well C were $16,028 and well D, $17,809, while the cost of the starch mud on well B to 13,900 ft. was $13,798.

Total mud cost on well B to 15,124 ft. was $24,480.84. This is low for the depth drilled with the size bits, lack of protective pipe, and the large mud system (2,200 bbl.) used. The mud properties at 15,000 ft. were: weight 10.8 lb., viscosity 52 seconds and water loss 4-6 cc. with oil 7%, and pH 8.0 to 9.0.

Drill pipe was not stuck, the hole was completely free throughout the drilling operations, and the casing was successfully set at total depth. Circulation was broken with only 1,200 lb. pump pressure after running the casing below 15,000 ft. This low pump pressure certainly indicates the excellent condition of the mud since time elapsed from laying down the drill pipe to breaking circulation after running casing to bottom was 26 hours.

After cement had set on this well, it was decided to drill out to establish whether salt had been drilled. The well was then drilled to 15,149 ft. at which time the mud indicated that the salt had definitely been reached. Drilling ceased and it was observed that the mud withstood the salt contamination very effectively. Before drilling out of the casing, water loss was 6.0 cc. After drilling 38 ft. into the salt, the mud was treated with 31 sacks of the starch (¾ lb. per bbl.) and the water loss was 5.6 cc. Resulting chloride content was 3,500-4,000 p.p.m.

Other wells. Two wildcat wells in Florida, seven others in Mississippi, two in South Louisiana, and two more in Alabama used this bacteriostatic starch. Each mud was low pH and many different drilling problems such as anhydrite and large shale sections were encountered. All were successfully drilled without fermentation.

Testing areas were selected to test the bacteriostatic condition of the new starch. At the same time, the results showed penetration rates to be similar to those in muds using other types of filtrate-reducing additives. This new starch also proved economical.

Acknowledgment

The author acknowledges the assistance of Dr. William Owen, of Baton Rouge, inventor of the nonfermentable starch; George H. Jett, of Jett Drilling Co., Shreveport; Harold M. Hoss and R. Lee Howell, of Gulf Coast Drilling & Exploration, Inc., Laurel, Miss.; George R. Grim, Jr., of Petroleum Management, Inc., Laurel, and many others who contributed greatly to the accumulation of the data presented, as well as that of the individual service engineers of the various mud companies operating in the areas mentioned.

Reference

1. A Nonfermentable Starch for Drilling Fluids, William L. Owen and William A. Romans, August 1958, World Petroleum.

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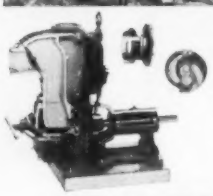

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Locust hordes reported! Place – the BP Research Centre at Sunbury-on-Thames. Here scientists are busy breeding and killing the insects to test new solvent oils which will provide even more effective bases for insecticides.

BP

New Corrosion Inhibitor Cuts Pull Jobs

Method of chemical injection	No. of wells	No. of pull jobs in wells treated with new inhibitor: Due to corrosion	Due to scale	Total	No. of pull jobs of wells treated with old inhibitor	Decrease using new inhibitor
Continuous	24	70	13	83	135	38%
Batch	13	17	8	25	35	28%
Total	37	87	21	108	170	36%

. . . equipment-replacement costs tumble in California tests

BY D. H. STORMONT
West Coast Editor

EXTENSIVE field testing of a new inorganic inhibitor has proved it highly effective in controlling corrosion of downhole equipment.

The tests were carried out by Standard Oil Co. of California, Western Operations, Inc., in 37 wells located in 8 different California fields. The wells chosen were known to have highly corrosive conditions. They also were ones on which performance records of other inhibitors were available.

Result is a substantial reduction in well pulling and equipment replacement costs. Continuous injection gave better results than periodic batch treatments.

The new inhibitor, developed by Standard's research subsidiary California Research Corp., is both nontoxic and chloride free. It is a compound of a type not previously used for oil-field corrosion mitigation. In field tests its inhibiting abilities were compared principally with an arsenical inhibitor also developed by Cal Research. This compound during the past decade has proved to be one of the most effective inhibitors for use with sweet crudes.

Test results. The 37 wells in which the inhibitor was applied ranged in gross production from a few barrels to more than 1,500 bbl. daily. In 24 of the wells the inhibitor was continuously injected into the tubing-casing annular space. The chemical was regulated so that the concentration of the water entering the pump would be about 15 p.p.m. In the remaining 13 wells it was batch-injected into the annular space 3 times weekly.

Data compiled during 1 year of the test showed the new inhibitor was 36% more effective than the arsenical compound.

A cost evaluation of the new inhibitor's performance is given in Table 1. As shown, a savings of $13,130 was realized over the 12-month period as a result of the change. This was accomplished even though the inhibitor cost 45% more than the one formerly used. Well-pulling costs were reduced about one-third and proportional savings were effected in rod and pump-replacement costs.

Shown in the cut above is effect of the method of treatment on inhibitor performance. There was a 38% reduction in well-pulling jobs at continuously treated wells, as compared with a 28% cut in batch-treated wells. Apparently continuous injection is more effective than batch treatment.

About 19% of the well-pulling jobs which occurred while the new inhibitor was being used was caused by scale accumulation. The scale is produced by the interaction of one inhibitor ingredient with dissolved iron present in the well fluids. The precipitate is insoluble in oil and brine and tends to form scale in pumps and on the rods and tubing.

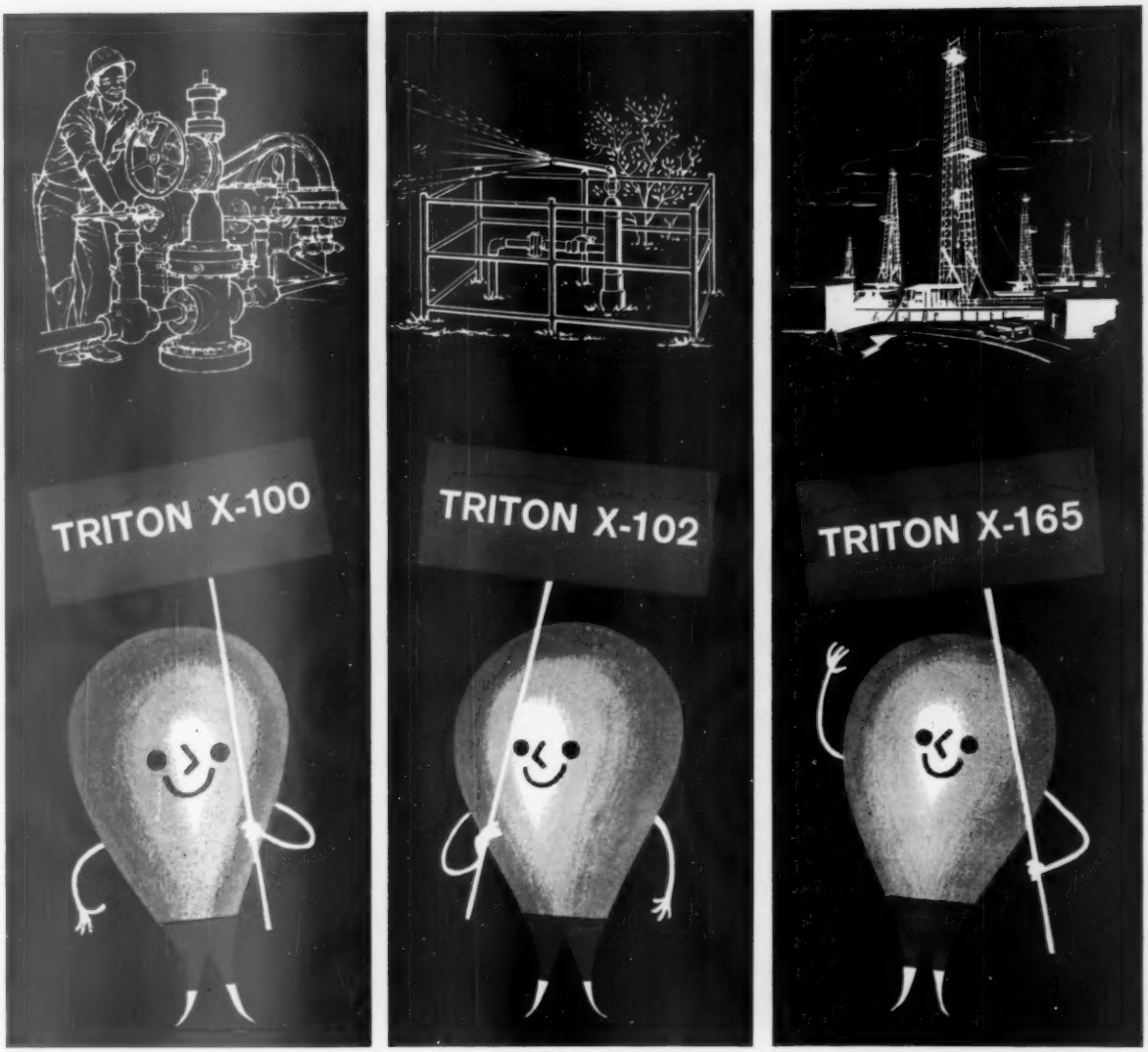
Scaling was not a problem in all wells, however. In those that tended to scale, the buildup occurred in a period of 3 to 6 months. The process was repeated when treatment was again applied after the well was pulled. The scaling tendency was found to be influenced by well temperature, as well as the amount of residence time of dissolved iron and inhibitor in the well bore.

The latter is reflected in comparative data on continuously and batch-treated wells. In batch-treated wells, scale accounted for 32% of the pulling jobs. Scaling caused only 16% of the pulling jobs in continuously treated wells. From the scaling viewpoint, continuous chemical injection therefore appears preferable.

While scaling is a problem, this shortcoming is usually outweighed by the superior inhibiting ability of the new chemical. And in the near future it is expected this problem will be reduced through a better knowledge of the factors which cause scaling.

TABLE 1—COST EVALUATION OF INHIBITOR PERFORMANCE (1 YEAR ANALYSIS)

	Cost using arsenical inhibitor	Cost using new inhibitor	Savings
Materials:			
Tubing	$ 1,696	$ 988	$ 708
Pumps	11,926	7,944	3,982
Rods	4,475	3,256	1,219
Boxes	462	405	57
	18,559	12,593	5,966
Pulling jobs	33,265	22,907	10,358
Inhibition	7,049	10,243	—3,194
Total	$58,873	$45,743	$13,130



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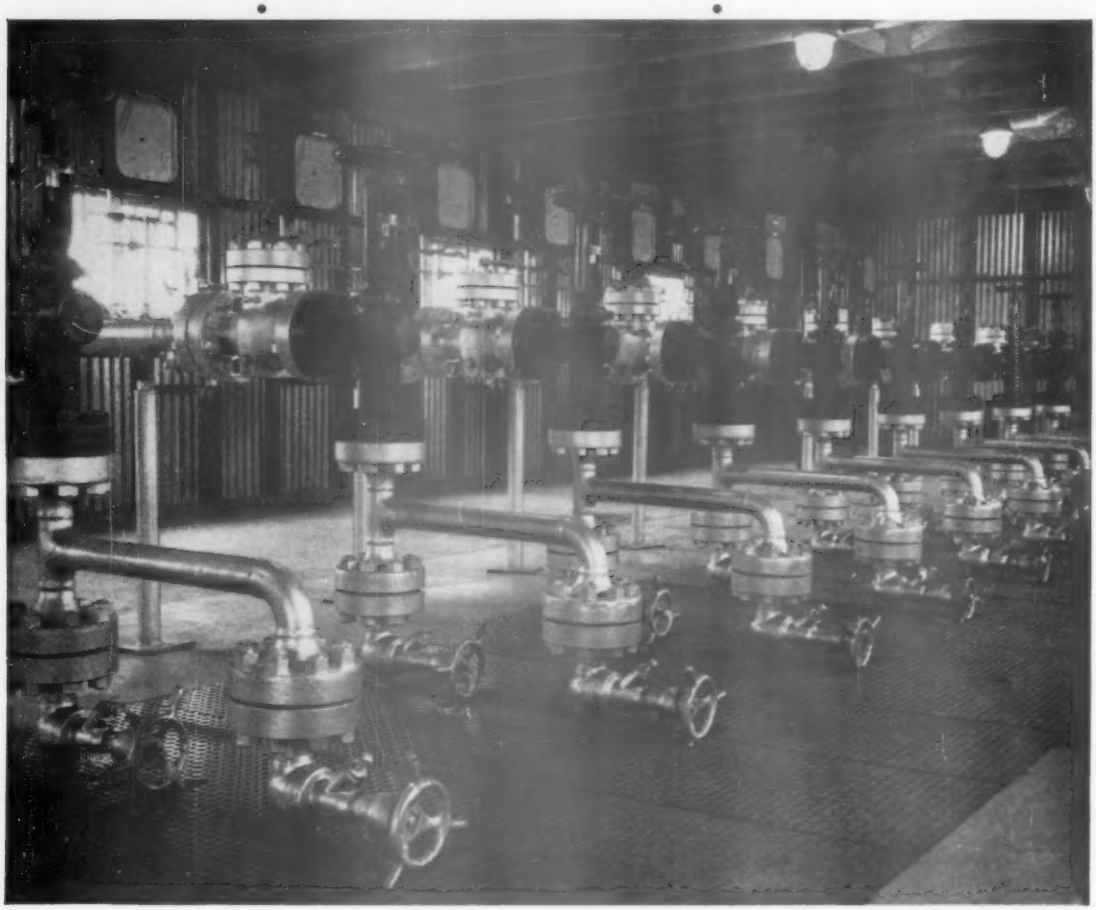

Orbit Forged Steel Production Valves in Service on Manifold for Gas Unit Near Freer, Texas. Gas from 20 wells is being fed into Hydrocarbon Recovery Unit.

Orbit Valves shown here are installed on continuous heavy duty service. Orbit Forged Steel Production Valves are so designed that seats contact only at closure. Dust and abrasives carried by gas from wells cannot get between seats because valve is self-cleaning and dust carryover is swept through valve by gas stream. There are no voids or cavities in the Orbit Valve for gases or fluids to become trapped in — when the valve is either in an open or closed position.

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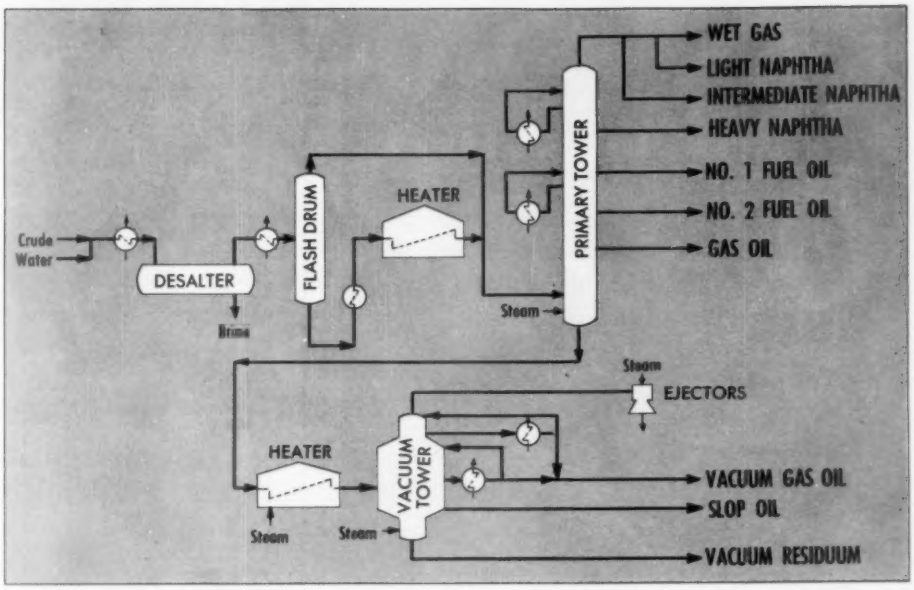
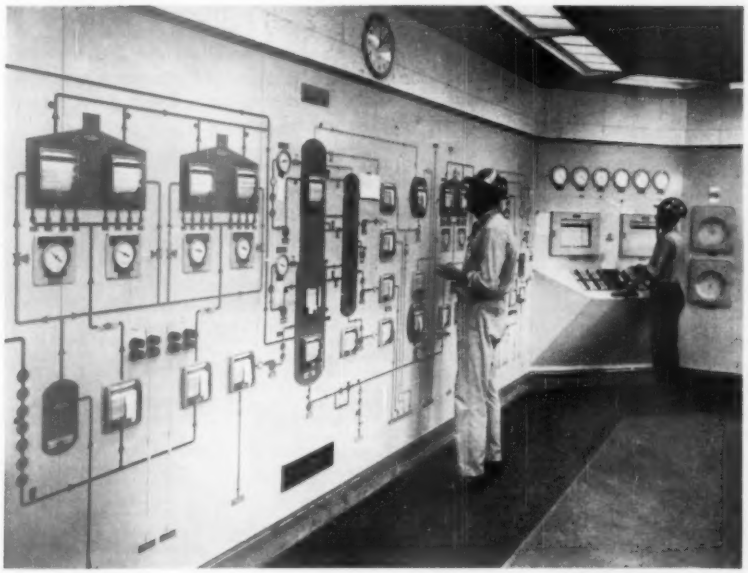


NEW crude unit processes 140,000 bbl. per day. It includes both a primary-distillation section and a vacuum-distillation section. Fig. 1.

How world's biggest crude-distillation unit operates

Indiana Standard's 140,000-bbl. plant features use of vacuum residuum from the unit as fuel oil, carefully designed plot layout, and efficient boiler feed-water heating system.

BY J. COLLINS AND R. A. HOLCOMB
Standard Oil Co. (Ind.)



COMPLETE PANEL BOARD is important feature of the crude unit's instrumentation.

WHAT IS BELIEVED to be the largest crude-distillation unit in the world is the 140,000-bbl. per stream day unit now operating at Standard Oil Co. of Indiana's refinery at Whiting, Ind.

The unit represents the completion of the first phase of an over-all modernization of the refinery to improve its competitive position, operating safety, and product quality.

Special Features

Several features of the design of unit are of interest and result from close attention to details of design by experienced technical and operating personnel, recent technological advances, and the large size of the unit.

Heaters. The direct-fired heaters are a special down-draft type specifically developed for firing with heavy residual fuels. They have an absorbed duty of 400 M.M. B.t.u. per hour and are fired by a combination of oil and gas. Vacuum residuum at 750° F. is used as fuel oil, and gas is used for temperature control. Use of this residuum for fuel oil eliminates the need for a separate offsite fuel-oil system and is expected to save at least $100,000 in annual operating costs. Atmospheric reduced crude is used for fuel oil during startup.

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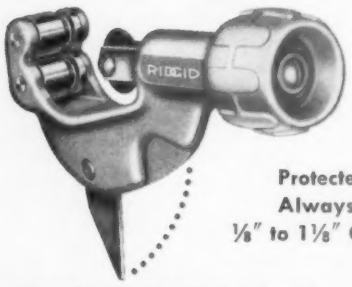

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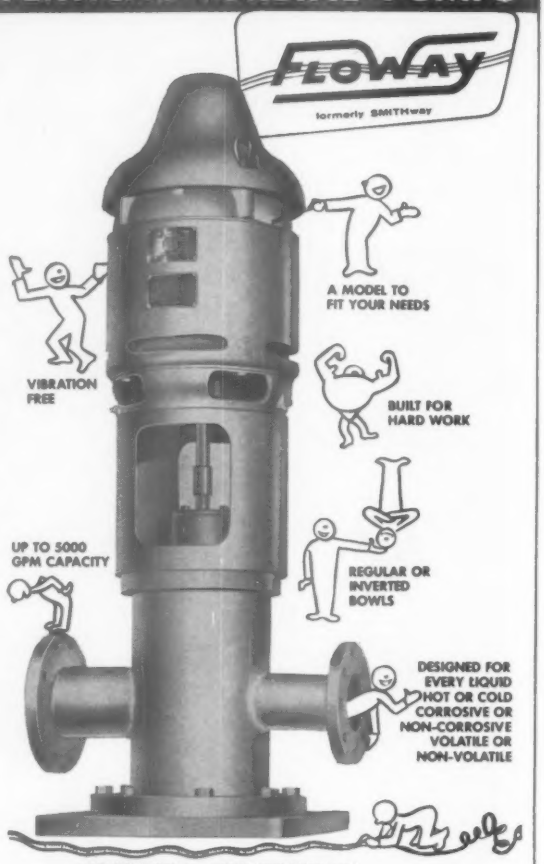
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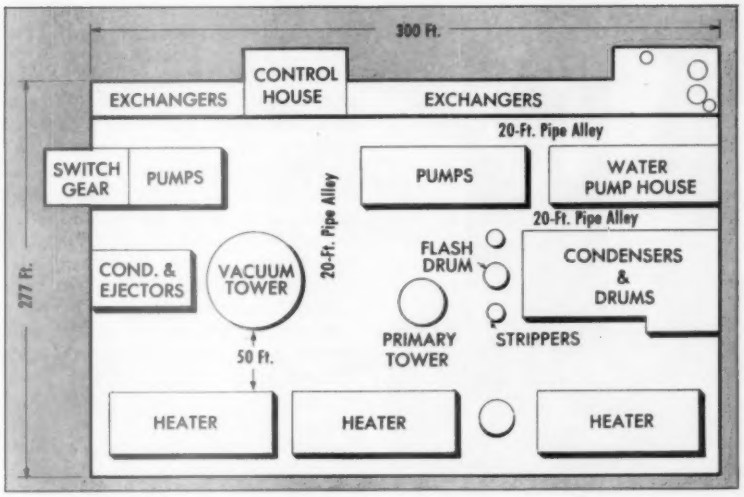


UNIT SITE is laid out to provide maximum safety and minimum maintenance costs, without incurring large additional investment costs. Fig. 2.

this unit, single pumps for four pumping services were found to be either unavailable, of new design whose service reliability had not yet been proved, or quite expensive. Therefore, half-capacity pumps were used for these services, and a single half-capacity pump was installed as a spare for the two normal operating pumps.

These installations have been entirely satisfactory. The practice does not have any greater operating liability than the common one of providing a common spare pump for two pumping services.

Motor drivers have been provided for normal operating pumps, and turbines exhausting to the atmosphere are used for drivers on spare pumps. The use of open dripproof motors rather than explosionproof motors, made possible by the development of silicone-rubber insulation, has reduced investment costs substantially. This saving stems, not only from a size-for-size lower motor cost, but also from the fact that open motors have 15% higher capacities.

Power. Electric power for the unit is supplied by a 5,000-kva. 4,160-volt double-ended substation which is located on the unit. Each 5,000-kva. transformer, which is capable of supplying the total power requirements, has a separate primary feeder from the refinery power station. This assures a continuous power supply to the unit in case of a failure of either power-supply cable.

The 480-volt and 208 Y 120-volt power-supply systems within the unit use a split bus arrangement with automatic-transfer equipment to assure a dependable power supply to all electrical equipment.

Other interesting features include:

- Size of the two distillation towers.
- Reduced-size valves.
- Boiler feed-water heating system.

The atmospheric tower is 23 ft. and 26 ft. in diameter and has an over-all height of 173 ft. The vacuum tower is 20 ft., 38 ft., and 11 ft. in diameter and has an over-all height of 140 ft. These vessels are constructed of mild steel and were fabricated, stress-relieved, radiographed, and tested in the field.

Since there is a substantial amount of large piping on the unit, most large valves are one size smaller than line size. This feature resulted in modest increases in pressure drop, but reduced investment costs by over $50,000. The resulting increased pumping costs are nominal.

A boiler feed-water heating system was installed on the unit to recover part of the heat normally transferred to a cooling-water system. A threshold water-treating system, pumps, additional exchanger surface, and the necessary piping were added to furnish about 4,000 g.p.m. of 180° F. water to the refinery power stations. This system conserves heat valued at about $500,000 annually.

Process Description

The unit is designed to process 140,000 bbl. per day of sweet crude with a gravity of 36° to 41° API and includes both a primary-distillation section and a vacuum-distillation section. Process flow is shown in Fig. 1.

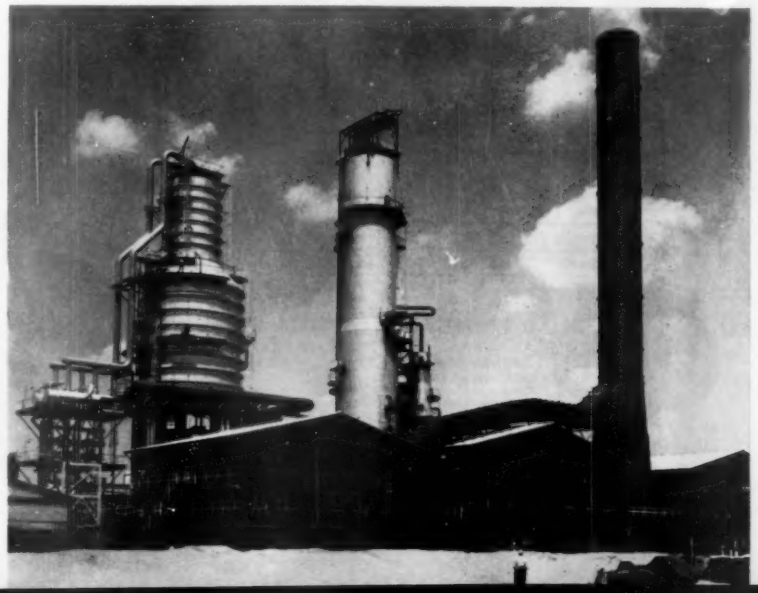
The crude is first preheated by exchange with product and reflux streams before it is desalted. After desalting, the crude is further preheated by exchange with products and flashed. The flashed crude, after additional heat exchange, is sent to a direct-fired heater. It is then recombined with vapors from the flash drum and enters the primary tower.

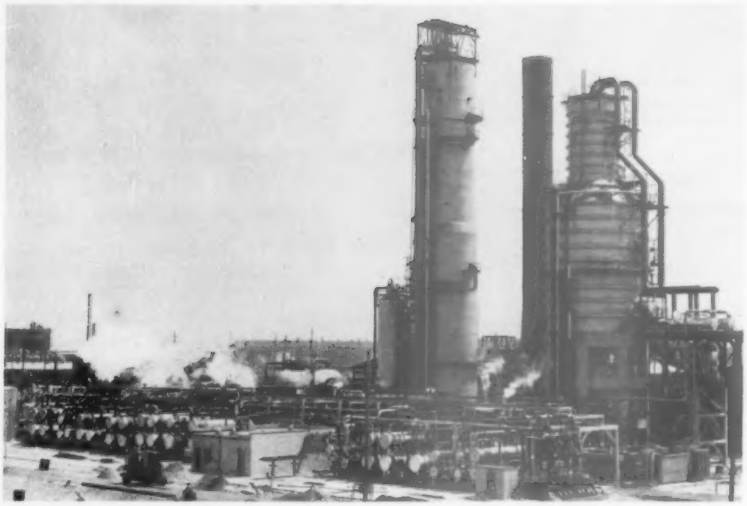
Intermediate and light naphtha are condensed from the overhead of the tower. Sidestreams of heavy naphtha, No. 1 fuel oil, or kerosine, and No. 2 fuel oil are stripped and cooled before leaving the unit. The gas-oil sidestream from this tower is cooled but not stripped. Temperature gradients are maintained by heat removal from two reflux streams.

The primary reduced crude is steam-stripped, heated in a direct-fired heater, and flashed in the vacuum tower. Steam is injected into the coils to decrease the oil residence time and eliminate cracking. Vacuum is maintained by three-stage steam ejectors which are sealed with barometric legs.

Two reflux streams are also used on the vacuum tower for heat removal, and slipstreams from these circuits are combined into one vacuum gas-oil

THREE DIRECT-FIRED HEATERS furnish the 400 M.M. B.t.u. per hour heat duty required by the units.





HUGE BATTERY OF EXCHANGERS is needed for economic operation of the big crude unit. Note the exchanger train in the foreground.

product. A slop-oil stream is also withdrawn to control carbon and metals content of the vacuum gas oil. Vacuum residuum is stripped in the vacuum tower.

Plot Layout

For safety, the unit is located a minimum of 250 ft. from other processing equipment or oil-storage tanks. This spacing minimizes possible damage to the unit in case of fire at an adjacent unit or tank. This spacing has also provided adequate areas for offsite roads and pipe alleys. The area is also used for exchanger-bundle pulling, furnace-tube pulling, and crane access to overhead equipment during turnarounds. Layout plot is shown as Fig. 2.

The unit site is laid out to provide maximum safety and minimize future maintenance costs without incurring large additional investment costs. The fired heaters are located at least 50 ft. from all vessels. Wide accessways with ample overhead clearances are provided for use by mobile equipment when handling tray parts, exchanger bonnets, pumps, motors, etc., and are directly connected to the refinery road system. Layout of equipment within the unit was governed to a large extent by the offsite investment cost of the large piping required for feed, product, and utility lines.

Fire protection for the unit includes lightweight concrete fireproofing for structural steel and vessel skirts, insulation with sheet metal jackets for blowdown piping, and 16 manually operated turret nozzles. Four of these turret nozzles are located above the pipe alleys within the unit and are operable from grade. These nozzles are extremely effective at this elevation and, together with the offsite turret nozzles, will permit flooding small fires with water from two or three directions. This fire-protection equipment is supplemented by hose reels, hand fire extinguishers, fire blankets, and snuffing steam for furnaces.

Startup and Operation

A crew of 27 process operators, each having at least 8 years' experience on refinery process units, was

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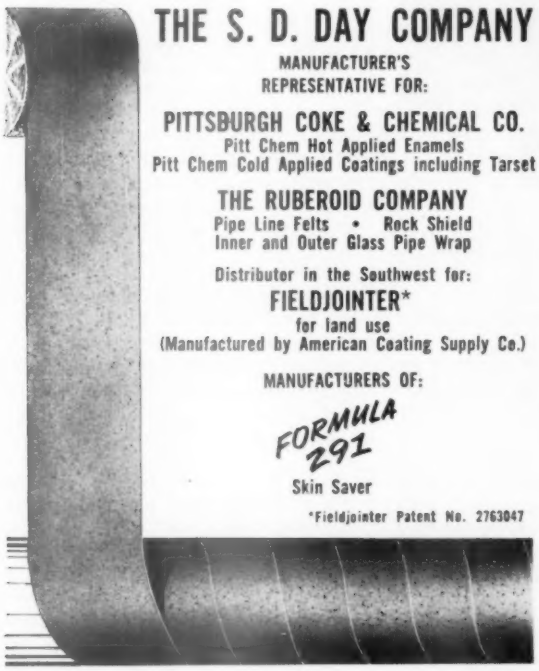

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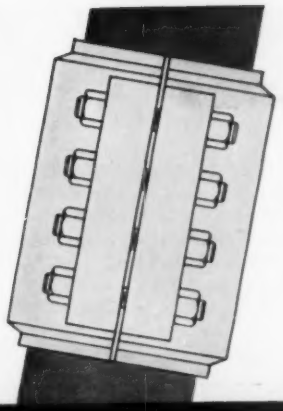

Completed Installation

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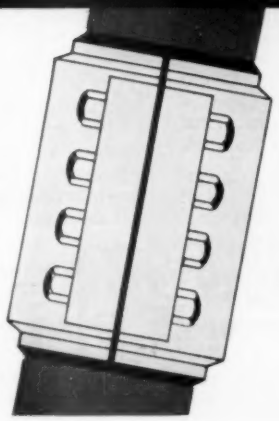

Completed Installation (When welding is specified)

THE PIPE LINE DEVELOPMENT COMPANY

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TABLE 1—TYPICAL DISTILLATE OPERATION

	°API	I.b.p.	5%	10%	50%	90%	95%	Max.
Inter. naphtha	74.2	92	115	125	170	208	230	240
Heavy naphtha	54.4	216	238	245	276	320	330	340
No. 1 fuel oil	43.2	319	359	379	441	506	520	546
No. 2 fuel oil	35.5	528	547	556	577	607	615	653

trained to place the unit on stream and maintain its operation. Considerable time was spent in reviewing detailed startup and shutdown procedures with particular attention to such items as drains, vents, hazards of water and air, and the application of check lists to augment written startup instructions.

Prestartup operations were carried out in the following order: First, all process lines, pumps, exchangers, etc., were thoroughly flushed with water to remove dirt and debris.

Second, all vessels, exchangers, and lines were steam-purged and tested to make sure all air was expelled from the unit and that flanges, etc., were properly closed for operation. The vacuum section after steam purging was placed under vacuum conditions.

Third, fuel gas was backed into the unit, with the exception of the vacuum tower, as steam was cut out.

Fourth, the unit was filled with a gas oil having a distillation range of from 450° to 700° F. and a flash of over 150° F.

Fifth, all process pumps were started up and run for 8 hours after which each pump was shut down and the temporary suction screen was examined. If clean, it was removed from the line.

Sixth, the gas oil in the system was pumped down to normal operating levels in vessels, while leaving the exchangers and piping filled with gas oil. The vacuum tower and its associated equipment and piping were left filled with gas oil, and the vacuum system was placed under vacuum.

Prestartup operations resulted in a very short startup period for the unit, since all equipment had already been in service to some extent. The unit attained full crude feed rate in 80 hours without difficulty, and products were on specification almost immediately. There were no pumping difficulties due to mechanical seal failures or plugged suction lines. Almost without exception automatic operation was attained and retained without trouble.

Products

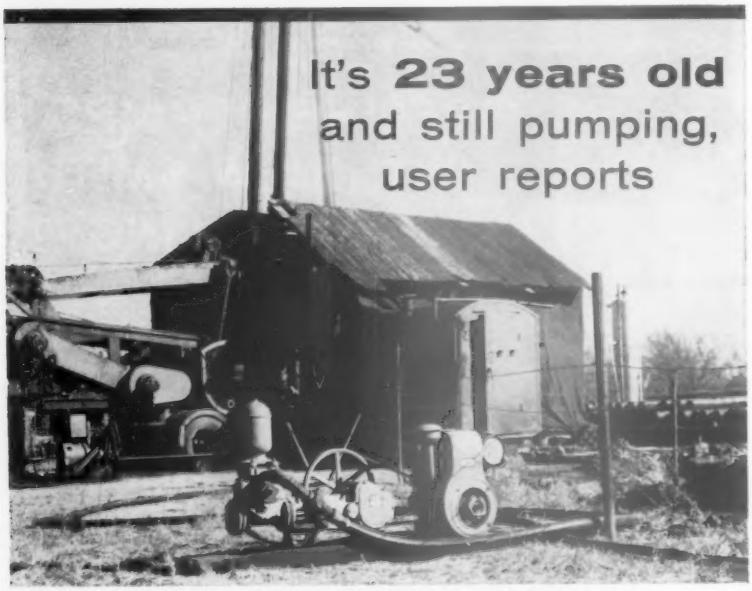
A variety of products can be made on the primary section of the unit. These are (1) light naphtha for motor-gasoline blending, (2) intermediate and heavy naphtha for reformer charge stock, (3) No. 1 fuel oil and No. 2 fuel oil for sale, and (4) primary gas oil for catalytic cracking charge stock. Products which can be made as alternates are kerosine, mineral seal oil, and diesel fuel.

Vacuum-section products consist of a single vacuum gas-oil product, a slop gas-oil stream, and vacuum residuum. The vacuum residuum is charged directly to coking units or blended, using continuous viscosity control, to No. 6 fuel specifications by adding cycle stock from catalytic cracking operations.

Vacuum residuum, blended with the slop gas-oil product, also supplies the feed stock for asphalt production and is pumped directly to a continuous oxidizer. The vacuum-gas-oil product is used as feed stock for both lube-oil production and catalytic cracking feed.

In both cases these streams are routed directly to the consuming unit. Most of the product streams leaving the unit are routed directly to consuming units or shipping tanks.

Fractionation in the primary section of the unit is very satisfactory.



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You bet we're proud of this service record. Especially when the user of the Wisconsin-powered unit shown toots our horn.

"Twenty-three years of service, and it's still a working horse," boasts Mr. Curt D. Edgerton, Sr., owner of the Curtis Oil Co., Sapulpa, Okla. He bought the 7-hp Wisconsin air-cooled Engine way back in March, 1937. Now it's busily powering this Goulds New Pyramid pump. And it still has plenty of life left, he adds.

Here's working proof that Wisconsin air-cooled Engines give the most hp-hours of on-the-job service.

What's more, as compared to water-cooled engines, you get the same rugged power *but with up to 26 fewer parts and ⅓ less weight.* And you never have to condition an air-cooled Wisconsin for summer or winter use. You just start it and let it run — whether it's 20° below or 140° F. above zero.

Take a tip from Mr. Edgerton — specify Wisconsin Engines for your utility units. Sizes 3 to 56 hp., with electric starting and choice of fuel system. And remember, we specialize in engine power applications for oil field use.

J-114

WISCONSIN MOTOR CORPORATION
Milwaukee 46, Wisconsin

WRITE TO HARLEY SALES CO.
615 SOUTH MAIN STREET • TULSA, OKLAHOMA
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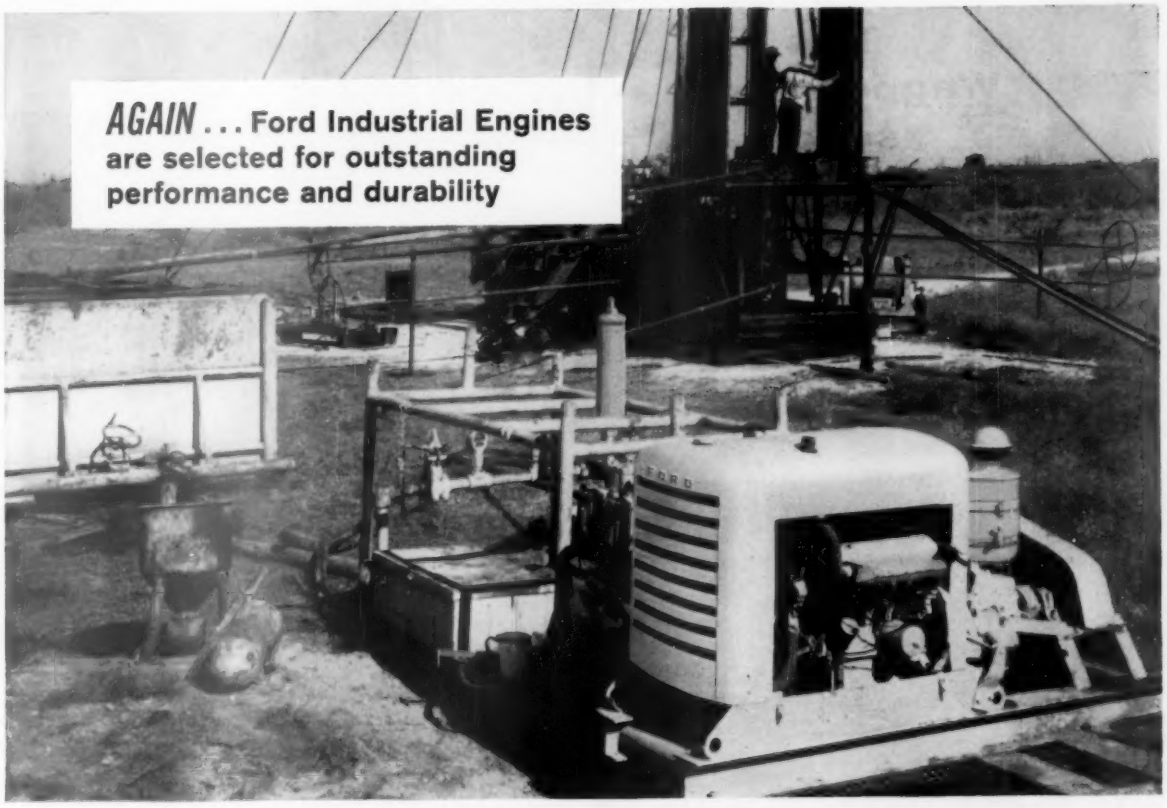
Oil Field Distributors for Wisconsin Engines and all types of Utility Units

World's Largest Builders of Heavy-Duty Air-Cooled Engines



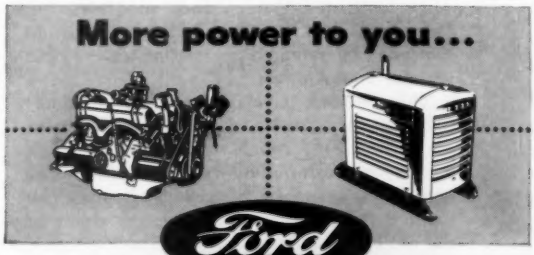
Rugged Ford-powered rig is still going strong after pumping heavy mud for 3 years!

The work-over rig shown above performs the essential task of "killing" oil wells with heavy mud or strong brine while they are being serviced. Its operator* reports that the Ford 272 Heavy Duty V-8 in the rig has been in constant use for 3 years . . . providing needed power *with no trouble at all.* Just as Ford power contributes to the effectiveness of this unit, a Ford Industrial Engine can bring a new kind of efficiency to your oil field equipment.

Ranging from 134 to 534 cubic inches, Ford engines offer many durability features including Short Stroke design that reduces friction and wear . . . Deep-Block construction that permits smoother operating performance . . . and full length water jackets that provide better cooling for longer engine life. Thanks to features like these, Ford engines give you an added bonus: *more horsepower per pound of engine weight than ever before possible.*

All Ford engines, including Ford's two modern diesels, are available as complete engine assemblies or power units. Gasoline engines can be adapted to LP-Gas or natural gas fuel. And because these engines can be serviced by any nearby Ford Dealer, costly downtime is cut to a minimum.

For more profitable production, it will pay you to power or repower your oil field equipment with a rugged Ford Industrial Engine. **Name on request*

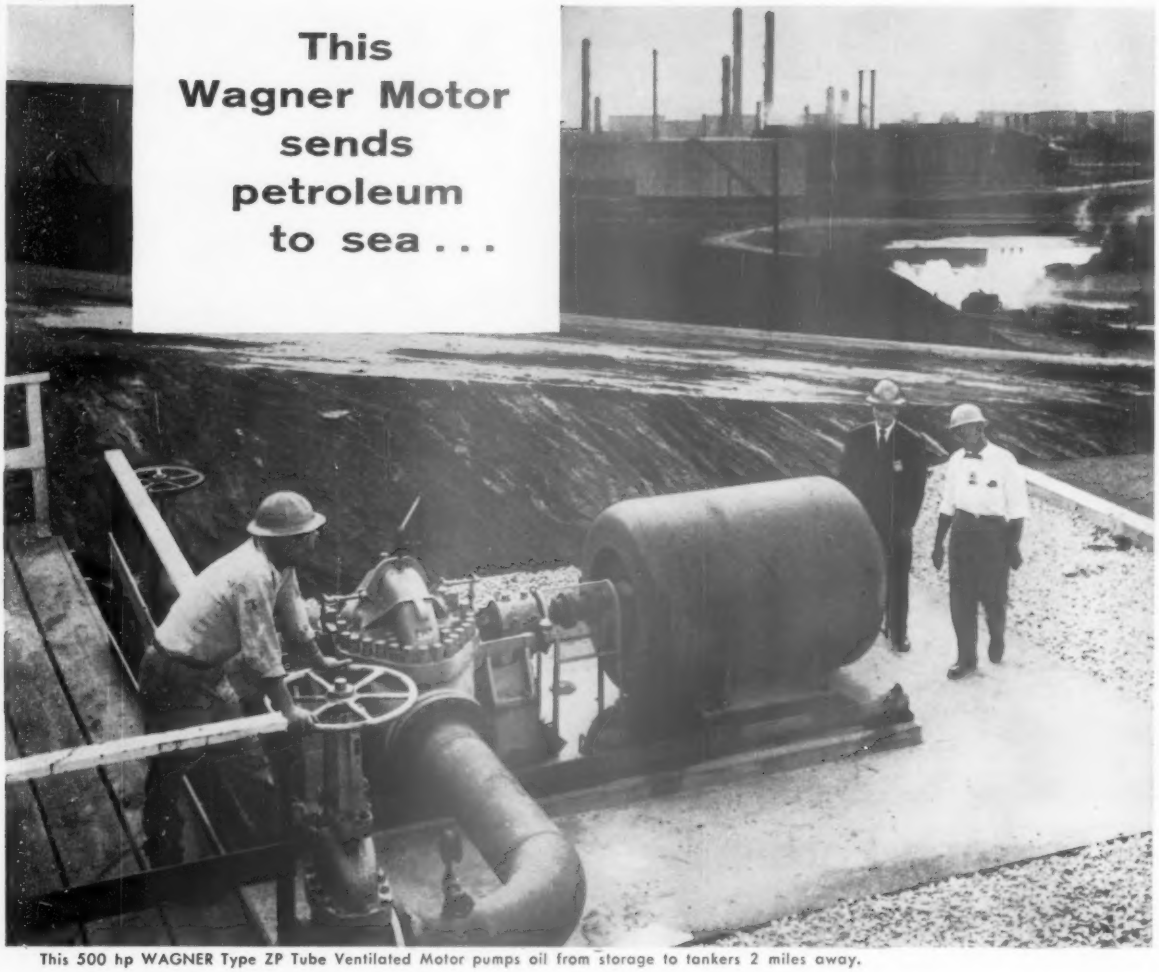


FORD POWER IS RIGHT FOR YOUR OIL FIELD EQUIPMENT, TOO!

INDUSTRIAL ENGINE DEPARTMENT, FORD DIVISION, FORD MOTOR CO., P.O. BOX 598, DEARBORN, MICH.

West of Rockies write to:
FORD INDUSTRIAL ENGINE DEPT., P.O. BOX 6787, LOS ANGELES 22, CALIF.
FORD INDUSTRIAL ENGINE DEPT., P.O. BOX 1666, RICHMOND, CALIF.

This Wagner Motor sends petroleum to sea . . .



This 500 hp WAGNER Type ZP Tube Ventilated Motor pumps oil from storage to tankers 2 miles away.

Big job, moving petroleum products to market. Standard Oil of California does it well . . . helped, at its El Segundo Refinery, by this 500 horsepower Wagner Tube Ventilated Motor. This explosion-proof motor's job: provide the power to pump crude oil from storage tanks down to the sea—and waiting tankers—two miles away.

Starting oil on a bon voyage is just one of many heavy-duty jobs performed by Wagner Tube Ventilated Motors. They also power big fans, blowers . . . any heavy-duty application that must be operated for long periods of time without a shut down.

These motors have fabricated steel frames that contain a series of tubes (as shown in photo below) through which cooling air is forced by an external blower. Internal blowers, one at each end of the rotor, circulate the warm air inside the motor through ducts in the rotor and stator and around cooling tubes. This effective cooling system holds the operating temperature of the motor within specified limits to lengthen motor life.

Whatever your motor requirements—large or small, for plant or product—Wagner can supply a standard motor or build a special motor to fit your needs. More than 65 years of constant research and development in electric motor design have made Wagner a name you can depend on. Call your nearby Wagner Sales Engineer for an analysis of your next motor application. There are Wagner branches in 32 principal cities.

WM60-11

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6389 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI

SERVING 2 GREAT GROWTH INDUSTRIES—*ELECTRICAL • AUTOMOTIVE*

▶ ▶ ▶ New Equipment Section

This week's SHOWCASE features . . .

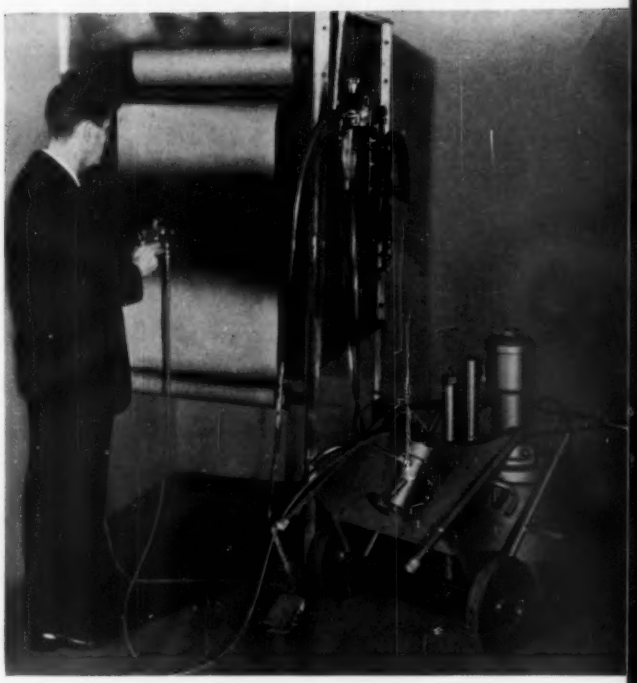
New airless spray gun licks flooding, pig-tailing problems

A NEW AIRLESS SPRAY GUN recently developed, along with improvements in the maker's accessory equipment, has removed all limitations of airless spraying for quality finish, the maker claims. The development promises to make possible the handling of any type of material with a 40 to 100% increase in efficiency over older equipment.

Two common problems of airless spraying, flooding and "pig-tailing," are reportedly done away with. Fluid pressure needed for proper atomization has been reduced to 40-50% of that required for older spraying equipment.

The maker further claims that the spray patterns are equal to the finest produced by air atomization and that the edges of the spray pattern are properly feathered to permit overlap without danger of runs or sags.

Materials which formerly required heat to be sprayed by the airless method can be sprayed cold with the Hydra-Airless 20 and H-gun with desirable results, the maker reports, and materials that could not be sprayed by the airless method because of control can now be sprayed with the new equipment. Source: **Spee-Flo Co., 6614 Harrisburg Boulevard, Houston 11.**



Hydrocarbon gases can be analyzed quickly, accurately

. . . with a new analyzer now obtainable. Called a HFI gas analyzer, the instrument furnishes a fast and accurate chromatographic analysis of hydrocarbon gases with the complete analysis through pentane being recorded in 5 minutes, the manufacturer reports. The analyzer has a high sensitivity (5 to 10 p.p.m. of hydrocarbons in an air sample produces usable peaks) with seven scales of attenuation from 1 to 1,000. No air peak is recorded since air is to be the carrier.

A companion product (also shown) is designated a HFI gas monitor. It gives a continuous monitor of hydrocarbon gases in drilling-mud streams. According to the maker, the equipment uses no filaments, columns, or thermal cells. And it is sensitive to methane of 1 to 5 p.p.m. in air. It, too, has seven scales of attenuation from 1 to 1,000. The system is pneumatic and includes metered air dilution for high gas shows and a low-volume hydrogen requirement that is self-generated and self-consumed as used. Delivery: 4 to 6 weeks. Approximate net price, f.o.b. factory, for either instrument is $1,985. Source: **Well Logging Equipment Mfg. Co., 3915 Tharp Street, Houston 3.**

MONITOR ANALYZER

Want more facts about equipment or copies of product literature described in this issue?

Send this **Showcase Coupon**

to manufacturer at address shown in bold type after each item.

Product name, Model no., literature title or number: .....

.....

Described in OIL AND GAS JOURNAL - Issue of **March 14, 1960**

NAME..... TITLE.....

COMPANY.....

ADDRESS.....

CITY..... STATE.....

Transco's 36-in. line goes through the marshes and over the ridge

THE JERSEY "MEADOWS" are in the distance, a no-man's land of muck, mosquitoes, and muskrats. Napp-Grecco laid some 8,500 ft of Bethlehem 36-in. pipe there.

LINE-UP CLAMPS READY, another joint is eased into place. The welded joints were X-rayed and hydrostatically tested.

Here's a pipe-laying job that beats 'em all for sheer orneryness.

Under a $1-million award, Napp-Grecco Co., of Newark, N. J., laid three miles of Transco's new, 36-in. looping line through the notorious New Jersey "meadows," then up and over the 300-ft-high rocky ridge bordering the Hudson River.

For six weeks the contractor's men and equipment slogged through the mucky meadows, at one point laying the pipe 16 ft below mean sea level. Then to the other extreme, drilling, blasting, and clawing their way through solid rock—working slopes so steep they had to anchor their backhoes to heavy tractors to prevent runaways.

To complicate things even more, it was necessary to burrow under a number of highways and, passing through city streets, they had to contend with a maze of underground utilities.

Finally, down the other slope they went, to connect up with dual 24-inchers recently laid across the Hudson River.

The pipe was Bethlehem's, widely used along Transco's 1800-mile-plus looping line from the deep South clear up to the streets of Manhattan.

Why not place *your* order for Bethlehem Line Pipe? It's available in any size you need, right up to 42 inches OD. *And with walls to ¾ in. in all the larger diameters through 42 in.*

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

ON TOP OF THE RIDGE, in a thickly populated area, the contractor had to thread the joints through a network of sewer, gas, and water pipes. Bethlehem produces expanded pipe with ¾-in. walls in the larger diameters, for use where higher safety factors are required.

BETHLEHEM'S ELECTRIC RESISTANCE-WELD PIPE was used for utility tie-ins all along Transco's main line. It's now available from 5⅝ in. to 16 in. OD in lengths to 60 ft. We also manufacture continuous buttweld pipe up to 4½ in. OD.

BETHLEHEM STEEL

NOW— FROM AMOT

MODEL 2900
VIBRATION VALVE

Offered as an accessory to the widely accepted 1476 series of Safety and Automatic Controls, the Model 2900 Vibration Valve detects and trips on excessive vibration of reciprocating or rotating machinery such as engines, compressors, motors, fans, pumps, etc.

FEATURES:

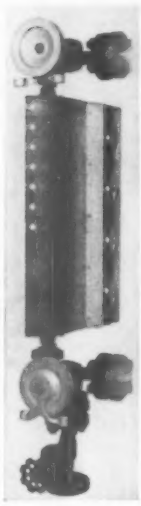
DUTY	For Pneumatic or Hydraulic Control Systems to 80 psi.
OPERATION	Three-way, snap acting, non-overlap valve action.
RANGE	Adjustable to amplitudes between .008" and .050" at 250 cpm and between .003" and .023" at 700 cpm or higher.
RESET	Built-in piston to reset control with 40-80 psi air; also provides means for time delay on start-up.

WRITE FOR BULLETIN 493

AMOT CONTROLS CORPORATION

OFFICES IN PRINCIPAL CITIES **RICHMOND, CALIFORNIA**

Boiler water gage



. . . for 3,000 - psi. working steam pressure, the Refraport gage, is designed to meet the needs of new plants being built for working steam pressures in the vicinity of 2,400 psi.

The water level shows black, similar to Reflex gages. The steam space above shows as a line of brilliantly lighted bullseyes with a clean line of demarcation which makes it easy to read the level directly or in TV or mirror transmission.

Using the principles of light refraction, the gage has a single chamber machined from a solid piece of steel, with front and back ports. Each port is covered with borosilicate glass, protected by a thin mica shield. Each glass has an individual cover.

An illuminator at the back of the gage throws a beam through the ports. Light passing through steam above water level, however, streams through the front ports in a series of brightly lighted spots. This gives a clearly visible water level. Source: **Jerguson Gage & Valve Co., 80 Adams Street, Burlington, Mass.**

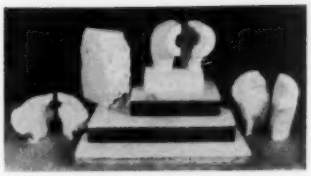
●

Drilling fluids

. . . field tested with a new rheometer now available. Licensed under a patent of Socony Mobil Oil Co., the instrument is a multiple-speed rotational viscometer designed specifically for field testing the rheological properties of drilling fluids at two rotational shear rates. Readings obtained are used to determine the plastic viscosity and yield point of drilling fluid.

According to the manufacturer, the instrument is easy and fast to operate and accurate. It is hand-powered by turning a small crank that drives a rotor at a preselected constant speed through a gear train and governor. Rotor speeds of either 300 or 600 r.p.m. are obtained by positioning a control lever. A third speed is obtainable for stirring samples.

Gel strength measurements are read directly from a deflection scale. A counterbalanced telescoping frame supports the rheometer. Rotor depth into the drilling fluid sample is easy to adjust. No electrical power is needed. Source: **Baroid Div., National Lead Co., Box 1675, Houston.**



Thermal-insulation

. . . cement doesn't shrink, the maker claims. The cement is a castable quick-set, one-coat type. Because it doesn't shrink, it can be packed by hand, troweled, injected, palmed, sprayed, or poured to any thickness, according to the maker, and it can

RECTIFIERS INSTALLED TO STOP PIPELINE CORROSION

Cathodic protection has proved to be a successful way to stop corrosion on pipelines, oil well casings, tanks, etc.—economically. And CSI engineers are pioneers in the field.

Case history: To protect pipelines in Central Texas, a major company asked for competitive bids on the installation of 12 rectifier systems. The contract was awarded to CSI; and was completed satisfactorily, on time.

CSI engineers furnished all the necessary labor, 23-foot augering equipment, ditching machines, trucks and other materials—meter loops, lightning arrestor poles, 90,000 pounds of coke breeze, graphite rods, cable, etc.

You, too, will find it pays to check with CSI for quality cathodic protection supplies of all kinds—for both rectifier and magnesium anode installations. Also for engineering and installation services.

Estimates or quotations without obligation. Ask for free copies of the latest CSI engineering reports.

CSI

Cleveland 13, Ohio
1309 Washington Ave.
Tel. CHerry 1-7795

CORROSION SERVICES INCORPORATED
General Office, Tulsa, Okla.
Mailing Address:
Box 787, Sand Springs, Okla.
Tel. Circle 5-1351

withstand freezing with no deteriorating effects.

The maker further claims that it is nonrusting and noncorrosive to metal and materials, especially aluminum. The cement can be applied to such hard-to-cover materials as glass fiber board and blanket, rock cork board, foam-glass block, and rock wool blanket without the use of wire.

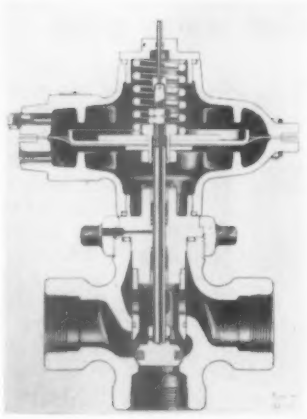
The K factors reportedly are considered low enough to be satisfactory for any temperature range. Delivery: immediate. Approximate list price, f.o.b. factory: from $1.97 per 50-lb. bag of hard-finish to $3.15 per 50 lb. bag of high-temperature insulation cement. Source: **Thermold Products Co., Grandview, Mo.**

•

Use 3-way valve

... two ways, as a regular three-way two-position diaphragm control valve, or plug one of the outlet ports and use it as a single-seat globe or angle-body valve. Designed for oil-production work, the Type 1664 valve has a cast-iron body with a 400-psi. water, oil, or gas rating. It comes in a 2-in.-size.

A hammer-lug union nut connects the bonnet to the body. This lets you



remove the internal body parts through the top of the body without taking the body from the line.

The lower seat is machined in the body. The upper seat is formed on a cast-iron cage screwed to the valve bonnet. A poppet-disk type of valve plug with a bonded Buna-n disk provides tight shutoff. The top works comes two ways: spring-opposed or pressure-balanced. You can reverse the spring-opposed top work in the field to obtain either fail-open or fail-close action. Details are given in Bulletin 0-15. Delivery: 2 weeks. Approximate net price, f.o.b. factory: $90. Source: **Fisher Governor Co., Box 307, Marshalltown, Iowa.**

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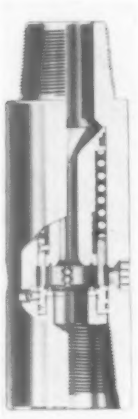
Jet drilling aid



... is a jet bypass valve now out that can be rented or purchased. The jet bypass valve is designed to provide auxiliary opening in the drilling assembly above the jet bit. In many instances, the selection of jet sizes in jet-bit drilling is governed by the ability of the jets to fill the pipe with fluid while running in the hole and to drain the pipe while coming out of the hole. When run with bits having extremely small jets, the valve permits normal fill of the pipe while running in the hole, thus reducing possible damage to lost-circulation zones because of pressure surges. When the drilling assembly is retrieved, the valve is in the open position, permitting the pipe to drain. This reduces the swabbing effect of the bit and does away with the need to pull wet strings of pipe. While cir-

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EXPERIENCE MAKES THE DIFFERENCE

...and a world of experience in testing thousands of miles of pipelines makes the difference in every Williams testing job.

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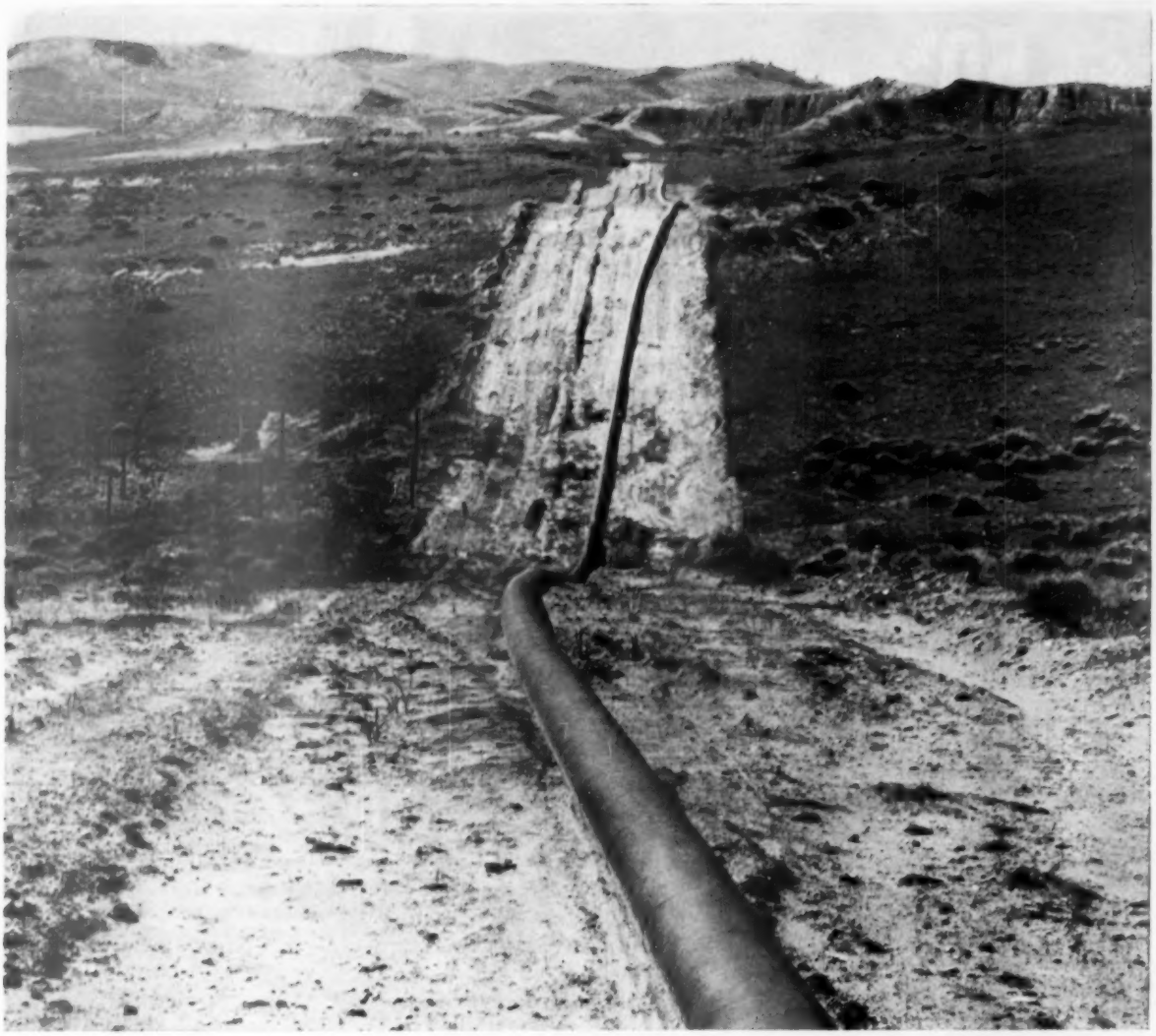
SPECIALLY DEVELOPED EQUIPMENT • COMPLETE TESTING SERVICE
EXPERIENCED TESTING ENGINEERS



Armco Line Pipe Combines Strength and Economy

New steels are born at Armco

Low residual stresses in line pipe mean more strength to handle unforeseen or accidental overloads. Tests show that the maximum residual stress in Armco Pipe is about 90 per cent less than in many commonly used standard pipes.

It's thrifty to specify Armco Line Pipe, too. You don't pay for "extra" steel—132 different diameter-wall thickness combinations let you meet your requirements *exactly*.

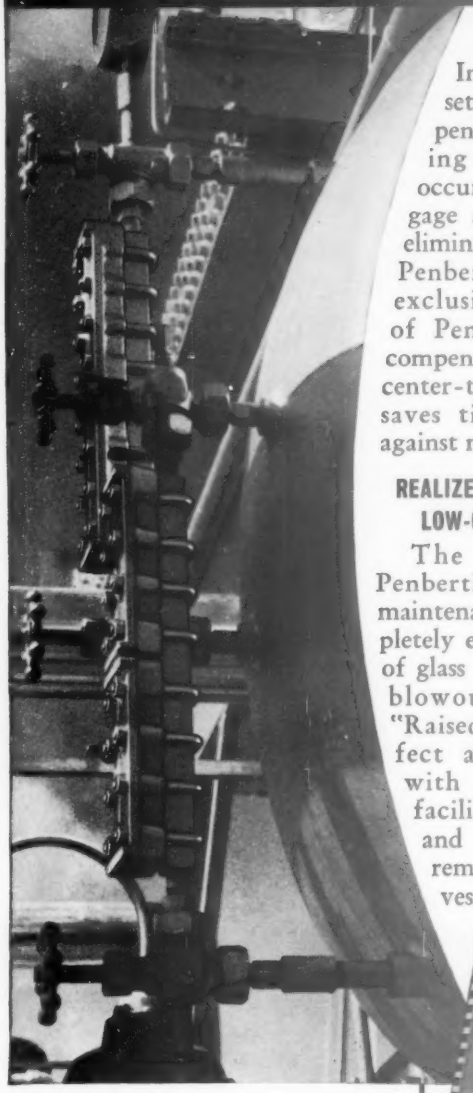
Write us for complete information on Armco Line Pipe. Armco Drainage & Metal Products, Inc., 5010 Curtis Street, Middletown, Ohio.

ARMCO DRAINAGE & METAL PRODUCTS

Subsidiary of ARMCO STEEL CORPORATION

OTHER SUBSIDIARIES AND DIVISIONS: Armco Division • Sheffield Division • The National Supply Company • The Armco International Corporation • Union Wire Rope Corporation

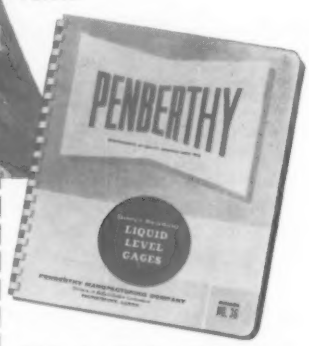
Save 50% or more
When you install PENBERTHY gage sets



Installing ordinary gage sets can be needlessly expensive and time consuming where inaccuracies occur in vessel tappings or gage assemblies. This is all eliminated when you mount Penberthy Gage Sets. The exclusive "Floating Shank" of Penberthy gage valves compensates for up to 3/8" center-to-center variation — saves time — and protects against mounting stresses.

REALIZE FURTHER SAVINGS IN LOW-COST MAINTENANCE

The unique design of Penberthy gages minimizes maintenance. The cover completely encloses sides and ends of glass and gasket to prevent blowouts. Full accessible "Raised Face" assures perfect alignment of frame with glass and gasket — facilitates cleaning, repair and maintenance without removing assembly from vessel.



Select the Right Gages for Your Requirements

REFLEX TYPE — 3 pressure groups to 3000 psig. Lengths to 12 ft.

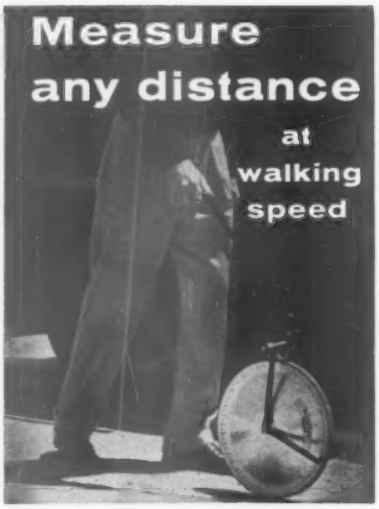
TRANSPARENT TYPE — 4 pressure groups to 10,000 psig. Lengths to 12 ft.

SPECIAL SERVICE TYPES — High pressure, Frost-proof, Heating tube and Heating chamber, Welding pad, Large chamber and Inclined gages, Explosion-proof illuminator.

Write for Catalog 36. Illustrates complete line in detail including technical data, selection chart, specifications and properties, installation-maintenance instructions.

PENBERTHY MANUFACTURING COMPANY
Division of Buffalo-Eclipse Corporation
PROPHETSTOWN ILLINOIS

Measure any distance at walking speed



records 100,000 ft. *automatically!*

It's So Easy to measure with a Rolatape ...and you save time on every estimating job...no tapes to wind, no helper is required. You get precision-accurate measurements every time.

Records Feet automatically and the accumulated total is always in full view.

Shows Inches, and Fractions of an inch. Wheel is calibrated in inches and fractions for quick easy reading.

Shows Tenths of a foot. Wheel is calibrated in tenths on reverse side for engineers.

Write for information and name of local dealer today!

Rolatape, Inc., 1741 14th St., Santa Monica 2, California

There is a variety of Rolatape Models to suit your needs. See them at your local dealers.

Rolatape
Measuring Wheels

culating, the valve is closed, directing fluid through the bit jets. Delivery: immediate to 3 days. Approximate price, f.o.b. factory: from $455 for 4¼ to 4½-in. o.d., to $550 for 7¾ to 8-in. o.d. Source: **Houston Oil Field Material Co., Drawer 2589, Houston 1.**

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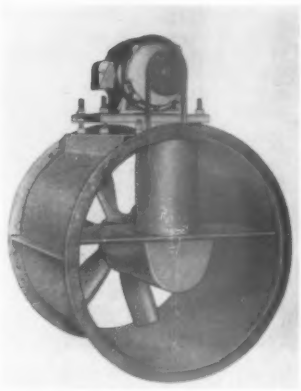

Duct fans

. . . made of glass fiber are now being produced in diameters from 12 to 36 in. According to the maker, the fans, under many conditions, offer resistance to corrosion equal to or exceeding that of stainless-steel or Monel construction.

The propeller, duct section, drive housing, and bearing cover on the fans are made of glass fiber. The drive shaft and other components are made of stainless steel. Features include variable-pitch drives which allow fast and easy adjustment of fan speed, fan noise, and air delivery. Details are given in Bulletin A-116A. Fan delivery time: 3 weeks. Approximate list price, f.o.b. factory: from $443 for a 12-in. to $1,383 for a 36-in. diameter. Source: **Hartzell Propeller Fan Co., Piqua, Ohio.**

•

New service saddle

. . . for pipe offers a method of applying clamping pressure with a wide, laminated strap, terminating in a short square-bend U-bolt at each end. This technique provides a flexible tension member which gives a close fit regardless of variations in pipe diameter or pipe irregularities, the maker reports.

The Type 310 service saddle is adaptable for use with all types of pipe within its rated size, including cast iron, steel, and Transite, according to the manufacturer. The saddle is provided with black malleable iron or bronze castings where threaded tees or corporation cocks are used. Delivery time: immediate. Approximate price, f.o.b. factory: from $2.25 for a 2-in. to $36 for a 30-in. size. Source: **Joslyn Mfg. & Supply Co., 3700 South Morgan Street, Chicago 9.**

Aluminum coating

. . . for roofs just announced improves with age, the maker claims. Under ideal conditions, the coating will reflect more than 70% of the sun's rays, thereby cutting down sharply on the amount of sun heat that is absorbed by the roof and transmitted to space underneath, according to the manufacturer.

Basically, the coating is for renovating old composition roofs where it covers cracks and small holes, revitalizes and protects the dried-out felt base, insulates by reflecting the sun's rays, and produces a bright, attractive appearance.

H-O-H*

GLUCOSATES*

Improved Through Research
Proven By Performance
The Best For Your
Water Treating Problems

WE READ WATER* A H-O-H ESTABLISHED 1931

Write for literature on your letterhead.

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ANALYSTS · CONSULTANTS · MANUFACTURERS
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AUTOMATION!

ARE YOU PLANNING REMOTE OPERATION OF YOUR ENGINES?

McCORD

HAS A COMPLETE LINE OF CONTROLS FOR

McCord Force Feed LUBRICATORS

VISUAL FLOW FILL CONTROL

Operates from central supply tank or engine crankcase.

Install in space of one lubricator feed. No machining or alterations necessary. Large sight feed shows make-up oil when called for by lubricator. Order part No. A31252.

LUB-SENTRY

Install in one pump space. Provision for pressure switch to shut down engine or sound alarm.

SIGNALS LOW OIL LEVEL OR MECHANICAL FAILURE

Contact your nearest McCord representative or write for catalog sheet McCord Lubricator Controls.

McCORD CORPORATION

LUBRICATOR DIVISION

DETROIT 11, MICH.

The asphalt-based aluminum roof coating will be available either fibrated or unfibrated in 5-gal. cans. Delivery time: immediate. Approximate list price, f.o.b. factory, $4.45 per gallon. Source: **Barrett Div. of Allied Chemical Corp., 40 Rector Street, New York 6.**

•

Two-way radio users

. . . now can get a new type of tone-squelch device that helps two-way radio users avoid hearing messages other than those of their own system. The new equipment contains no relays or electromechanical devices. It can be used with the maker's wide and narrow band TPL mobile units.

The tone accessory is connected with a nine-conductor cable. Source: **General Electric Co., Communication Products Department, Lynchburg, Va.**

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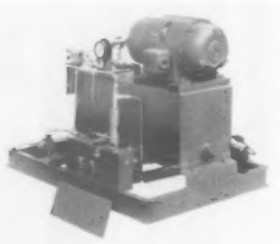


Compressor

. . . that is hydraulic-driven for gas booster service is on the market. The compressor, the maker claims, provides oil-free gas at 10,000 psi. The Model SS-2 compressor is a single-acting two-stage type that provides average gas flow rates of 16 s.c.f.m. To prevent oil or other conventional lubricants from being introduced into the gas system, the natural lubricating properties of special glass-filled Teflon compression rings and composition bearings on the gas piston are used. The gas is cooled by water in an intercooler and an aftercooler.

The unit consists of a hydraulically driven booster compressor, hydraulic power unit, and a cycling control package. These are integrally contained within a single frame structure.

The hydraulic power units are available in pump-motor ranges from 4.8 g.p.m., 7.5 hp. to 9.3 g.p.m., 15 hp. Each unit is complete with oil cooler, accumulator, reservoir, and sight gage. Delivery: 90 days. Approximate net price, f.o.b. factory: from $5,000 for the smaller size to $5,800 for the larger size. Source: **Haskel Engineering & Supply Co., 1236 South Central Avenue, Glendale 4, Calif.**

WELL CORROSION?

inhibitor squeeze with CORBAN

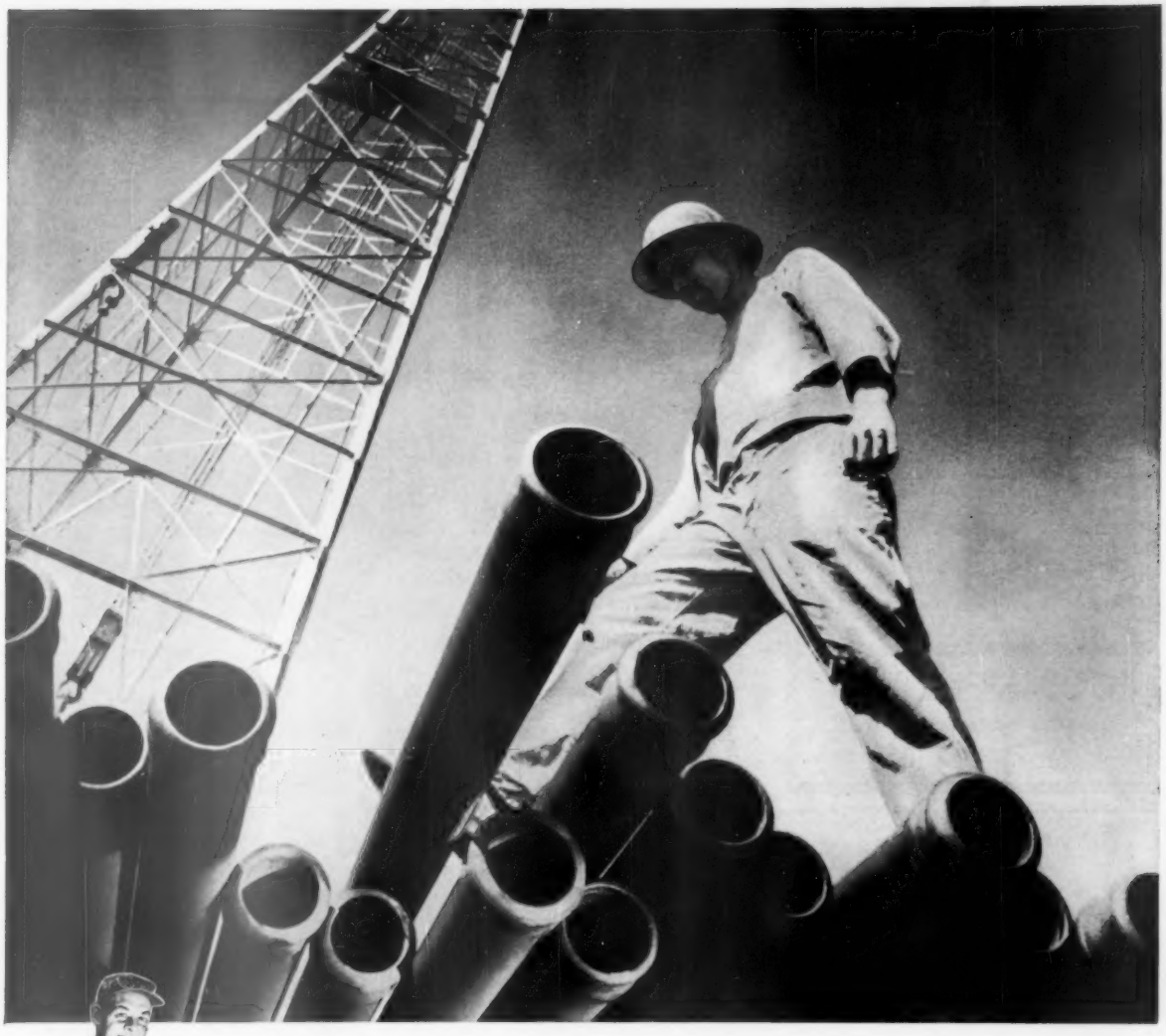
The "squeeze" method of applying Corban®—the Dowell family of corrosion inhibitors—involves pumping the inhibitor through the tubing string into the producing formation. The metal parts contacted by the Corban receive a protective film of inhibitor. As the well is produced, Corban from the formation maintains this protective film for an extended period. "Squeezing" with Corban has been especially beneficial—particularly in wells previously difficult to treat. Get an engineered recommendation from Dowell on the use of Corban.

Products for the oil industry

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

DIAL DOWELL



What's behind the demand for

CF&I Seamless Casing and Tubing?

Look at the company and what it represents. For the petroleum industry, the Image of CF&I stands for a high grade of seamless casing and tubing. The steel used is made by CF&I. Manufacturing facilities and equipment are among the most up-to-date in the industry. CF&I's production techniques feature unusually exact quality controls. For special technical problems, CF&I offers expert engineering services.

CF&I's mill is ideally situated in Pueblo, Colorado. Around it, a thousand miles in every direction, stretch the rich oil fields of North America. This location facilitates rapid delivery, either by rail or truck, even to the most remote sites. All CF&I Seamless Casing and Tubing is made to API specifications. It's available in sizes 2⅜" to 9⅝" O.D. Get full details from a CF&I Sales Representative or your local distributor.

7524

CF&I STEEL **SEAMLESS** *casing and tubing* API

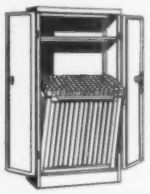
THE COLORADO FUEL AND IRON CORPORATION • DENVER, COLORADO

STOP H_2S CORROSION BEFORE IT STARTS!

• The Connelly IRON SPONGE purification process at the well site removes hydrogen sulphide BEFORE the gas is piped to central processing. Thus, the cause of pipe line corrosion is eliminated because corrosive gas never enters the transmission lines. Additionally, Connelly IRON SPONGE eliminates the need for extreme close control. It operates with high efficiency at low or high pressures—absorbs more H_2S, gives longer service between foulings and is easily regenerated. If you have a purification problem check this MOST ECONOMICAL solution today. Write for Field Processing Bulletin #OG-7.

CONNELLY, Inc.

3164 SOUTH CALIFORNIA AVENUE
CHICAGO 8, ILLINOIS
ELIZABETH, NEW JERSEY

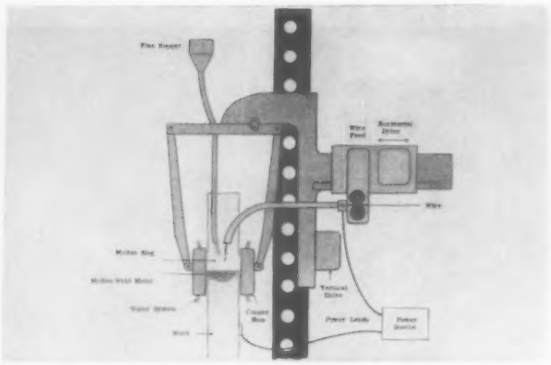
MAP  FILE

CONFIDENTIAL — DOORS LOCK!

The sturdy MT4 steel cabinet map file has 112 tilting tubes. Easy to file and find maps, tracings and blue prints to 60" lengths. Keeps valuable information dust proof and confidential. Popular everywhere in both field and home offices. Write for illustrated information.

SHIPPED IMMEDIATELY FROM STOCK
Patent No. 1610368. Other Patents Pending.

SCOTT-RICE CO., 610 S. Main, Tulsa 19, Okla.



Lower-cost vessel fabrication

. . . may result from a new vertical welding machine now being introduced. The machine, designated Vertomatic, is fully automatic and permits continuous, one-pass arcless fusion welding of pressure vessels, tanks, and plate up to 10 in. thick at significant savings in time and material, the maker reports.

Using an electroslag welding principle, the machine is adaptable to plate and forgings from 1½ to more than 10 in. thick that can be set up in the vertical position. It can be easily used for girth seam welding.

The electroslag welding principle is an arcless process that takes advantage of the ability of molten slag to carry an electric current. The resistance of the slag to the current creates a high heat that melts both the filler metal and the adjacent parent metal, resulting in their coalescence as a weld.

The machine can weld such joints as butt welds, T-joints, corner welds with inside fillet, and reinforcing surface welds. All machine operations are directed from a control panel and are normally automatic. Delivery time: 2 months. Approximate price, f.o.b. factory, ranges from $17,000 to $23,000, depending upon whether one or three 1,000-amp transformers are desired. Source: **Arcos Corp., 1500 South Fiftieth Street, Philadelphia.**

THE HOTEL

in the Oil Capital of the World

100%
Airconditioned
600 Bright *Reasonably* Priced Rooms

THE MAYO

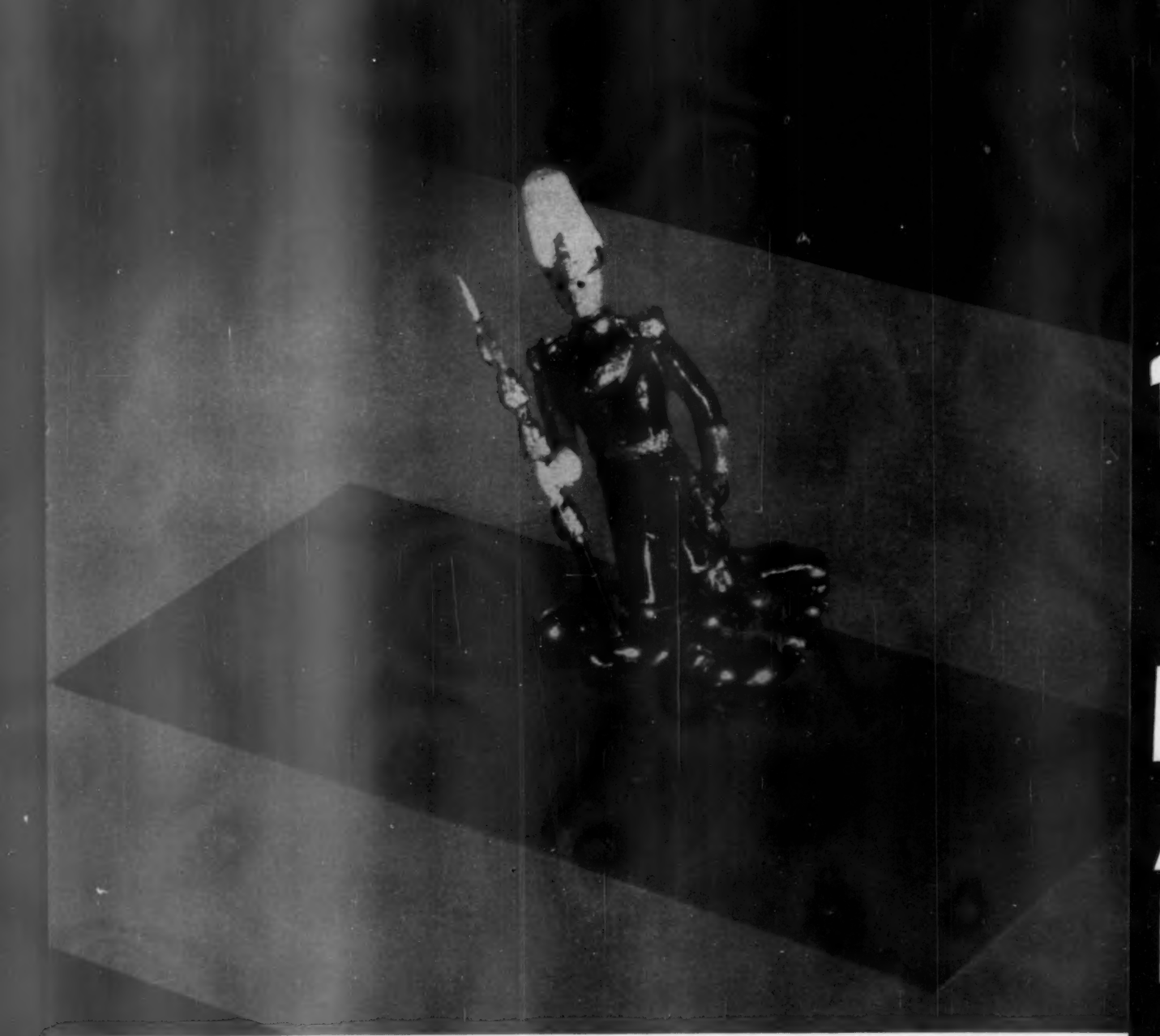
TULSA'S *Finest* HOTEL
Sample Rooms · Finest Food
Adjacent Garage

W. C. NORRIS

Field Tested and Approved
150 psi working pressure

WRITE FOR NEW VALVE BULLETIN
P. O. Box 1739, Tulsa

VALVES



The coating that heat can't fade away

A Glidden RUSTMASTER H.R. coating was applied to an outdoor hot plate. One year of 900° F. surface temperatures *and* constant exposure to all kinds of weather had no adverse effect on the heat and water resistant film. Unlike the old lead soldier the coating was unharmed.

This unique *outdoor* hot plate test, the only one of its kind, is just an example of the many ways all Glidden coatings are tested and proven.

Glidden Protective Maintenance Coatings are designed and specifically test-proven to match particular requirements wherever protection of chemical, railroad, petroleum, marine and industrial equipment is a problem.

QUALITY Glidden PRODUCTS

COATINGS FOR EVERY PURPOSE

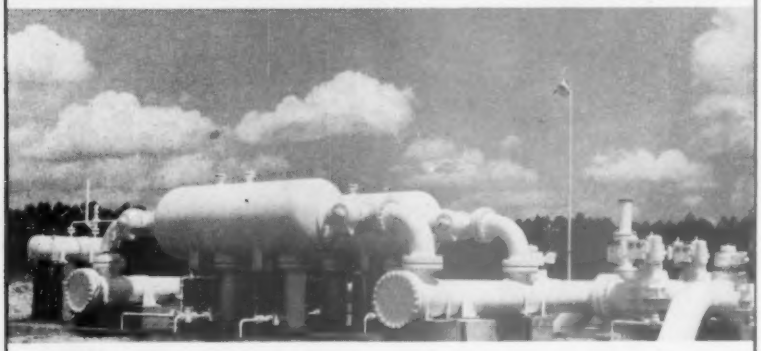
The Glidden Company
INDUSTRIAL PAINT DIVISION
900 Union Commerce Building • Cleveland 14, Ohio
In Canada: The Glidden Company, Ltd., Toronto, Ontario

Write for your free copy of booklet containing complete information on all Glidden Protective Maintenance Coatings.

FLINT STEEL

PRESSURE VESSELS

Dot America's PIPELINES



Scrubbers—Snubbers—Air Tanks—Drip Tanks

These and many other processing and storage units for Natural Gas Pipelines are fabricated by Flint. More than forty-five years of heavy and light plate fabrication experience, combined with the largest and most modern plate manufacturing facilities in the Southwest enables Flint to fabricate to specifications on time.

SPECIALISTS IN STEEL FOR INDUSTRY

Write for booklet describing Flint's new steel fabricating facilities.

FLINT STEEL

P. O. BOX 1289 • LU 4-3621
TULSA 1, OKLAHOMA

STEEL PLATE FABRICATORS ASSOCIATION

SHOWCASE . . .

New Literature

Electronic computing

. . . system known as Model RPC-4,000 is detailed in new Catalog S-482 now available. The model is a fully transistorized, electronic, stored program, general-purpose computing system, for both engineering and business-data processing. The 2-page publication contains photos, basic-system data, features, and specifications. Source: **Data Processing Div., Royal McBee Corp., Port Chester, N. Y.**

Eddy-current coupling

. . . adjustable-speed drives for 5 to 100 hp. is outlined in a new bulletin, GEA-6885. The 12-page publication contains data on the coupling's operating principle, torque capabilities, regulation, and operation of the entire packaged drive.

Cross-sections and artist's drawings outline construction features. Charts indicate drive-unit dimensions of the control enclosure and operator's control. Source: **General Electric Co., Schenectady 5, N. Y.**

Steel-equipment

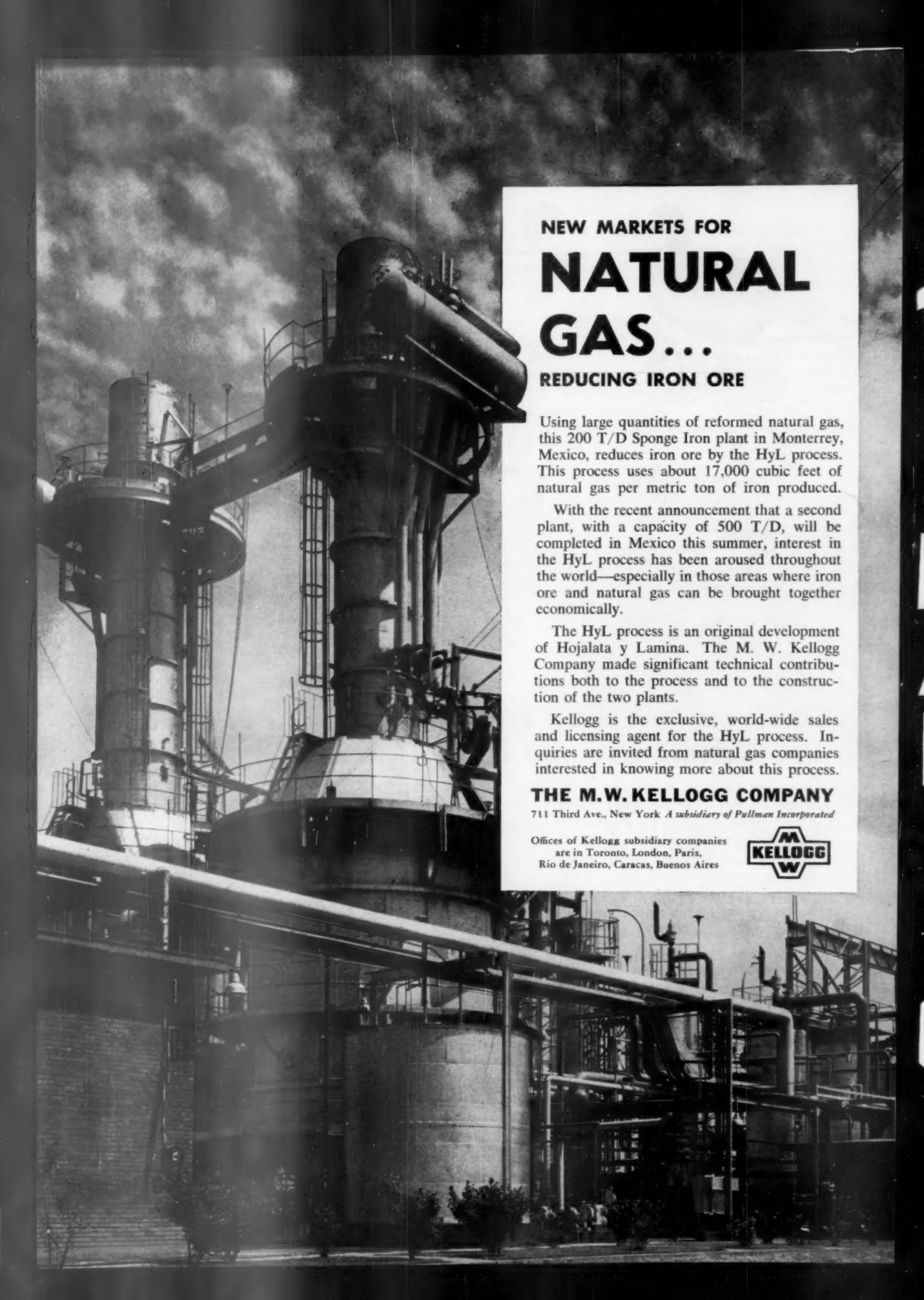
. . . catalog contains product views, complete specifications, and installation views depicting products in action. Available gratis upon request, Catalog 100-H illustrates office machine cabinets and tables, typewriter attachments, drawing tables, woodworking benches, desk-high or full height bookcases, drawer tool stands, etc. Source: **Lyon Metal Products, Inc., 1 Plant Avenue, Aurora, Ill.**

Study of Fine Particles

. . . Manual 3 describes methods of isolating, sizing, counting, and identifying fine particles in air, gas, and liquid streams. Featured is a new plastic filter material capable of removing submicron particles from fluids and gases.

The membrane filter can effectively remove all particles from water, fuel, hydraulic fluids, and critical air supplies, according to the publication. It can also be used for evaluating the cleanliness of liquids and gases, as particles filtered from a test batch of liquid can quickly be viewed under a microscope for total particle count or for size determination.

Chemists can use the membrane to filter even the finest colloidal systems. Particles filtered from air, fuel gas, or



NEW MARKETS FOR

NATURAL GAS...

REDUCING IRON ORE

Using large quantities of reformed natural gas, this 200 T/D Sponge Iron plant in Monterrey, Mexico, reduces iron ore by the HyL process. This process uses about 17,000 cubic feet of natural gas per metric ton of iron produced.

With the recent announcement that a second plant, with a capacity of 500 T/D, will be completed in Mexico this summer, interest in the HyL process has been aroused throughout the world—especially in those areas where iron ore and natural gas can be brought together economically.

The HyL process is an original development of Hojalata y Lamina. The M. W. Kellogg Company made significant technical contributions both to the process and to the construction of the two plants.

Kellogg is the exclusive, world-wide sales and licensing agent for the HyL process. Inquiries are invited from natural gas companies interested in knowing more about this process.

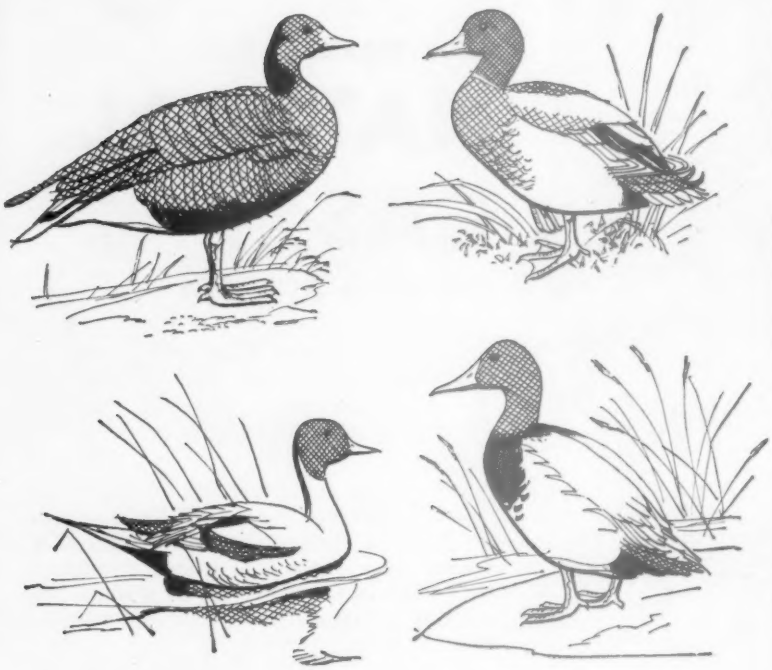
THE M.W. KELLOGG COMPANY

711 Third Ave., New York *A subsidiary of Pullman Incorporated*

Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

KELLOGG

Which is the Canvasback duck?



Can you tell the real thing when you see it?

You can be sure of getting the genuine article every time when you buy chemicals made by Wyandotte! Product line of uniform quality, including materials for drilling muds, gas dehumidification, demulsifying, emulsifying, secondary recovery, water treatment, cementing, sweetening and many other petroleum, refinery, and petrochemical applications. Get full details from your distributor, or write: *Wyandotte Chemicals Corporation, Wyandotte, Michigan. Also, Baton Rouge, Louisiana. Offices in principal cities.*

ANSWER: That's a goose at the upper left. The three ducks are: Mallard (upper right), Pintail (lower left), and Canvasback (lower right).

WYANDOTTE CHEMICALS

Wyandotte CHEMICALS

MICHIGAN ALKALI DIVISION

PACING PROGRESS WITH CREATIVE CHEMISTRY

SODA ASH • CAUSTIC SODA • BICARBONATE OF SODA • CALCIUM CARBONATE • CALCIUM CHLORIDE
CHLORINE • MURIATIC ACID • HYDROGEN • DRY ICE • GLYCOLS • SYNTHETIC DETERGENTS
SODIUM CMC • ETHYLENE OXIDE • ETHYLENE DICHLORIDE • POLYETHYLENE GLYCOL • PROPYLENE OXIDE
PROPYLENE DICHLORIDE • POLYPROPYLENE GLYCOL • DICHLORODIMETHYLHYDANTOIN • CHLORINATED SOLVENTS
OTHER ORGANIC AND INORGANIC CHEMICALS

liquids can be spot tested on the filter for qualitative identification. Millimicrograms of material thus can be identified. Source: **Gelman Instrument Co., Chelsea, Mich.**

Ductile-iron pipe

. . . and fittings brochure should prove helpful in solving pipe-corrosion problems where piping is exposed to extreme chemical and acid conditions. The newly published 24-page brochure contains tables which: (1) set forth the physical and metallurgical properties of ductile-iron pipe; (2) compare its corrosion resistance in various media; and (3) give specifications of ductile-iron pipe and fittings with flanged joint, Clow Bell-Tite joint, and with plain or threaded ends. Source: **James B. Clow & Sons, Inc., 201 North Talman, Chicago 80.**

X-ray techniques

. . . used today for industrial quality control and scientific research are shown on a new 11½ by 22-in. wall chart, yours for the asking. Methods listed are (1) industrial radiography and fluoroscopy; (2) industrial fluoroscopy with image intensifier; (3) X-ray absorption; (4) X-ray fluorescence absorption; (5) projection microradiography (X-ray microscopy); (6) contact microradiography; (7) X-ray diffraction; (8) X-ray diffractometry; (9) X-ray spectrography (fluorescence); and (10) electron microbeam probe.

The chart shows a simplified diagram for each one of the techniques with explanatory notes and a discussion of application fields. Source: **Philips Electronic Instruments, 750 South Fulton Avenue, Mount Vernon, N. Y.**

Facts on Filteraids and Fillers

. . . is the title of a 2-page sheet describing diatomite and perlite fillers and filteraids, the use of diatomite as insulation, and diatomite-asbestos and carbon-based filteraids. A graphic table permits quick comparison of various types in terms of specific gravity, particle size, color, moisture absorption, and other factors.

Shown in chart form are the flow-rate characteristics of eight conventional grades of diatomite, one of perlite, and one of carbon. Another chart shows sizes of particles removed from a liquid by five grades of diatomite filteraid.

Characteristics are shown for diatomite in both its uncalcined form and in its calcined and process-calcined

Suspension bridge for huge pipeline designed for safety with USS Tiger Brand Wire Rope

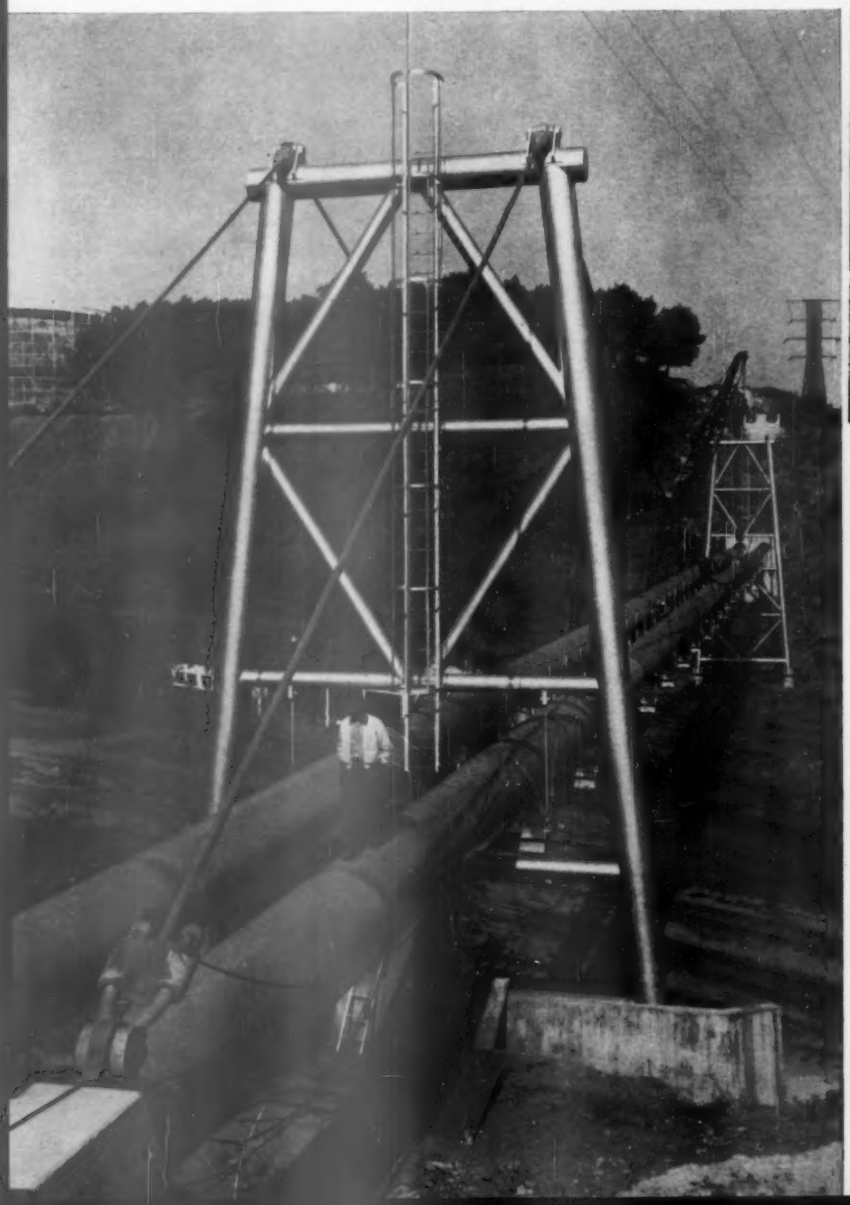
Carnegie Natural Gas Company reports that this is the largest pipeline for gas transmission ever carried over a suspension bridge. It consists of twin parallel pipes each having a 54.5-inch inside diameter for 7.9 miles. The remainder of the pipe is 42.5-inches I.D. for 4.3 miles. The pipeline originates at the Clairton, Pa. Coke Works of United States Steel and terminates at the Homestead Steel Works.

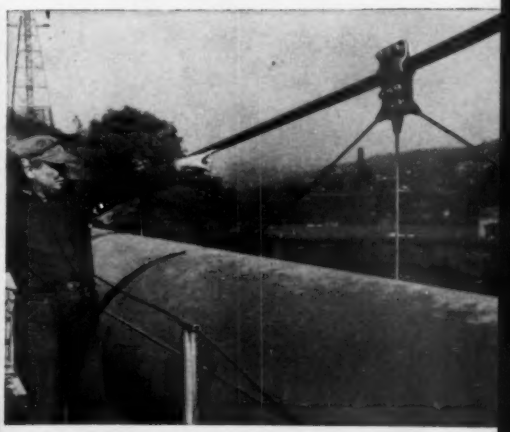
The main span of the bridge uses two USS Tiger Brand Galvanized Bridge Strands each 2¾ inches in diameter, 367 feet long and composed of 175 wires. The vertical and diagonal supports are made from ⅝-inch diameter 6 x 7 extra galvanized bridge rope with strand core. The pipe is anchored to steel beams with ½-inch diameter 7-wire galvanized Amerstrand with a clevis-type swedge fitting on one end and a threaded-type swedge fitting on the opposite end.

In addition to the bridge strand ropes used for the bridge, all wire rope used on the pipe laying equipment was also Tiger Brand. For information about any type of wire rope, strand or slings write Dept. 0147, American Steel & Wire Division, 614 Superior Ave., N.W., Cleveland 13, Ohio.

USS, Tiger Brand and Amerstrand are registered trademarks

Pipeline suspension bridge built with USS Tiger Brand ropes and strand for utmost safety.
Owner: Carnegie Natural Gas Company, Pittsburgh. Engineers: Williams Bros. Company, Tulsa, Okla. Contractor: American Bridge Division





Why USS Tiger Brand is your best buy

Tiger Brand Wire Rope is designed by the country's leading wire rope engineers. It's made and researched with the most complete facilities in existence. When you buy Tiger Brand you get the right rope for the job. And your installation is no further away than a phone call to experienced American Steel & Wire field service representatives or your USS Tiger Brand Distributor.

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad

"Torture tests prove W-K-M performance"

Continuous research and rigid testing give W-K-M customers constantly improved valves and fittings. In this test cell, for example, W-K-M products are tested far beyond calculated limits of endurance . . . even to complete destruction.

Specify W-K-M! You'll get superb quality and unmatched dependability. Write for literature on W-K-M products.

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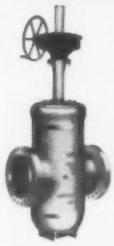
W-K-M's Pressure Sealing Gate Valves (ASA)—Catalog 1200

ACF non-lubricated Ball Valves— Catalog 1000

KEY-KAST® Alloy Welding Fittings— Quality Control Specifications 102958 and 103058



W-K-M Through-Conduit Gate Valves (ASA)—Catalog 300

ACF® lubricated Plug Valves—(Semi-Steel) Catalog 400, (Steel) Catalog 1100

KEY® Refinery Fittings and Return Bends— Bulletin KR-1257

5927

forms. Special-process perlite characteristics are indicated, as well as characteristics for carbon-based fillers. Source: **Great Lakes Carbon Corp., 612 South Flower Street, Los Angeles 17.**

Rotameters

. . . for corrosive service literature piece gives details of materials used in manufacturing. Eight-page Bulletin 150 illustrates and describes in detail various types of meter designs which have been proved in the field. Source: **Brooks Rotameter Co., Hatfield, Pa.**

Control catalog

. . . lists mercury-switch-equipped controls for single and two-stage pressure, differential pressure, single and two-stage temperature, liquid level, and mechanical movement. Catalog 860 also illustrates transformer-relays and hermetically sealed mercury switches. Each control, with accompanying description, specifications, and engineering data, can be located quickly by a dual index contained in the catalog. Source: **Mercoid Corp., 4201 Belmont Avenue, Chicago 41.**

Flexible couplings

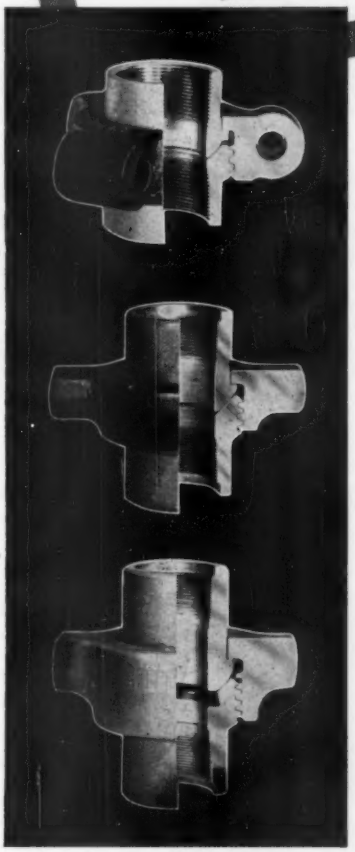
. . . of metal for maintenance-free power transmission are discussed in revised Catalog 60. The 52-page publication describes misalignment, assists in selecting couplings for specific requirements, classifies loads, and groups various coupling types for simple selection. Photographs of couplings and installations, diagrams, and tables for each type of coupling comprise the main part of the literature.

The catalog gives facts on bore and keyway standards, dynamic balancing, and ordering instructions. Newly added to the catalog are miniature couplings. Style applications and special couplings designed for specific conditions are also shown. Source: **Thomas Flexible Coupling Co., Warren, Pa.**

Business sign

. . . selection is discussed in a new folder available now. It stresses that it is important to obtain a sign properly identifying the place of business and one suiting the personality of the business.

Seven photographs illustrate some interesting uses of Plexiglas letters on signs for typical operation. Letter fonts are shown, plus the sizes in which they are available. Source: **Amplex Mfg. Co., 2325-31 Fairmount Avenue, Dept. 66, Philadelphia 30.**



Standardize with WECO Unions on all your piping for leakproof connections and simplicity of make-up. When you standardize with WECO Unions no time is lost in locating matching unions. WECO Unions in same sizes and pressures not only match perfectly with each other but are unsurpassed for making and holding a tight seal under all conditions of surge and vibration.

Full circle contact of the ball and cone metal-to-metal seats always makes a tight seal.

Save money and time, standardize on WECO Unions, proved best on the hardest service applications. At your Supply Store in sizes 1″ through 12″, pressures 1,000 psi through 15,000 psi.

U-8-88

WELL EQUIPMENT MFG. CORP.
HOUSTON, TEXAS

WECO

Division of CHIKSAN COMPANY *a subsidiary of* FOOD MACHINERY AND CHEMICAL CORPORATION

fmc

▶▶▶ Equipment Men Notes

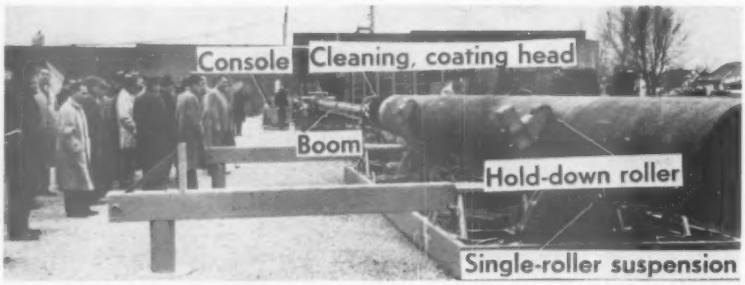
Internal cleaning, coating machine displayed

. . . by Crose-Perrault Equipment Corp., of Tulsa, to more than 100 pipeline men. The machine, developed and built by Crose-Perrault, is for 16 through 36-in. pipe. Only two basic cleaning heads are required for all pipe within this size range. The electric-driven machine is available to the pipeline industry now on either a sale or lease basis.

High-speed-circular wire brush promises efficient cleaning, and the retractable brush unit lessens pipe-entry damage. Brush pressure is indicated on the operator's console and can be adjusted during operation to meet varying surface conditions. The large-capacity continuous-operation vacuum-pickup system removes rust and scale during cleaning and coating operations.

This system also eliminates the problem of clouds of dust being blown back on freshly coated surfaces. An airless type coating-spray system uses hydrostatic pressure to atomize paint, eliminate 90% of overspray and coating bounce-back. Use of a 360° spray head prevents build up or lap at juncture of spray pattern.

The coating-pump unit, mounted on a power car for easy accessibility, is designed to minimize expensive coating waste. All phases of the machine are controlled from a centralized push-button console. A crew of four can operate the machine. The unit can be broken down and moved from one job site to another, or it can be anchored to concrete foundations for permanent installation.



FEATURES of Crose-Perrault's pipe-turning-roller unit include a single-roller suspension and hold-down roller—patented features which eliminate pipe walkage while permitting high-speed rotation.

Sooner Pipe & Supply promotes

. . . Sidney Selinger and Jean F. Brown to assistant vice presidents. Selinger has been with the corporation since 1951, serving as traffic manager and head of the tubular-goods department. In his new position, he will continue to supervise both departments. Brown has been with Sooner Pipe & Supply for 15 years.

At the same time, it was announced that Bill Webster had been added to the sales staff. He will serve as city salesman for Tulsa.

McEvoy Co. begins expansion

. . . program which will cost $400,000, announces George A. Butler, president of the Houston-headquartered oil-well-equipment firm. New equipment has already been installed at a cost of $250,000, and additional expansion will be completed soon at a cost of $150,000.

Don G. Rhodes is sales engineer

D. G. Rhodes

. . . of oil-field sales for Nordberg Mfg. Co., reports R. W. Bayerlein, vice president of the Milwaukee firm's Engine Division. Rhodes brings to his new position more than 25 years of sales and engineering experience in the oil fields. He will work with distributors and users of Nordberg Power Chief engines on production pumping and water-flooding applications.

Presently located in Wichita, Rhodes eventually will headquarter in Tulsa to serve the Mid-Continent area. The newly appointed sales engineer formerly spent 10 years with Bethlehem Steel Co. as division machinery engineer.

Ingersoll Corp. to handle sales and service for Caterpillar

. . . engines in the Arkansas-upper Louisiana area. A dealer store is located at Shreveport (shown above) and comparable facilities are scheduled to be opened in Little Rock to provide parts and service for Caterpillar customers. Announcement of the exclusive dealership was made by F. V. Jacobs, sales manager of Caterpillar's Engine Division.

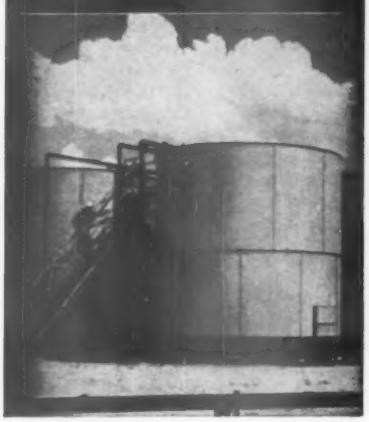
Ingersoll Corp.'s Shreveport facilities include full parts and service building, sales area, and a fabrication-assembly plant for special adaptation of Caterpillar engines.

M. B. Skinner Co. announces

. . . the following newly elected lineup of executive officers: K. G. Merrill, chairman of the board; F. R. McMurray, president; and H. T. Waite, Jr., vice president in charge of sales. Waite, former sales manager, has been with the company 25 years.

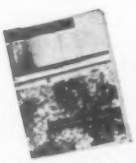
Skinner, headquartered at South Bend, Ind., manufactures repair clamps and saddles for steel and cast-iron pipes, and tees for services.

STOP CORROSION ON INSIDE OF TANKS



STANDARD MAGNESIUM ANODES WILL PROTECT AGAINST ALL CORROSION INDEFINITELY!

For less than $9.50 per year you can **completely stop** corrosion on the inside of an average 100 barrel tank! Think of the thousands of dollars in replacement costs this will save! Many major companies use Standard Magnesium anodes on waterflood tanks, storage tanks, filters and other vessels where the interior walls are particularly susceptible to corrosive liquids. Easily installed by your own employees, here is the **positive** way to increase the life of your tanks **indefinitely!**



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National Tank Co., Ltd. promotes

Tracy E. Smith

. . . three at a recent annual meeting of the stockholders and board of directors. Tracy E. Smith was elected president, general manager, and a director. A. H. vanderLee became a vice president, assistant general manager, and a director. W. A. Law was made assistant secretary-treasurer.

Smith joined National Tank Co. as a warehouseman in the Pampa, Tex., branch in 1940. Following World War II he rejoined the company in Tulsa. In later years he became district engineer, branch manager, division engineer, chief sales engineer, vice president and manager of National Tank Co., Ltd., and board member of both National Tank and its Canadian subsidiary.

A. H. vanderLee

W. A. Law

vanderLee joined the Canadian concern in 1949 as a sales and service engineer in the Edmonton branch. After serving as Edmonton branch manager for 5 years, he was promoted to general field superintendent in the Edmonton area. In 1958 he became assistant general manager at Calgary.

Law became associated with National 12 years ago as office and warehouse clerk. He later worked as general office manager and was in charge of setting up and supervising the branch offices of National Tank Co., Ltd.

Engineered Oil Tools sets up

. . . regional warehouse and service points at Odessa and Oklahoma City, announces Peck Meier, general manager. The West Texas branch is headed by W. B. Jennings. E. G. Williams supervises the Mid-Continent warehouse and service branch.

William J. Bergeron joins

. . . Selas Corp. of America, Dresher, Pa., as sales representative in the Houston sales district. He will repre-

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sent the firm's Micro-Processing Division throughout Oklahoma, Louisiana, and Texas, in the sale of equipment for removing solid, liquid, or vapor contaminants from fluid systems. His sales activities will also include Selas' new generation and purification equipment for producing high-purity hydrogen.

Bergeron joins Selas from Sterling Packing & Gasket Co., Houston, where he was a sales engineer. He was previously associated with Celanese Corp. of America, and Diamond Alkali, both located in Pasadena, Tex.; and Great Southern Chemical Corp., Corpus Christi.

John T. Knight is transferred

. . . to Midland, Tex., as West Texas district manager for Norvell-Wilder Supply Co. He will also have charge of the company's Midland, Tex., sales office. For several years, Knight was sales office manager for the company at Tulsa.

Bucyrus-Erie Co. appoints

. . . Turner's Drillers Supply, Inc., of Albuquerque, (already a B-E drill distributor in New Mexico and Western Texas), as exclusive distributor for B-E oil and water-well drills in Oklahoma.

From its newly opened branch office and supply store at Okmulgee, Okla., Turner's Drillers Supply will offer sales and service on a complete line of Bucyrus-Erie water and oil-well spudders, along with the sale of truck-mounted rotary and down-hole combination drills for water-well drilling.

Charles R. Turner, vice president of the recently incorporated supply organization, is in charge of sales for the Oklahoma territory.

M. W. Chambless is appointed

M. W. Chambless

. . . area sales and service manager of the Southwest Texas area of McCullough Tool Co.'s Eastern Division. He succeeds the late Tom Parsons in this position.

Chambless joined McCullough in 1944 at Tyler, Tex., having 10 years of previous experience in the oil fields and in wireline operations. In 1949 he was promoted to district sales and service manager at McAllen, Tex., a position he has held for the past 10 years.

Marvin Gunter is appointed

. . . district manager of microwave and industrial product sales in 10 southern states for Motorola Communications & Electronics, Inc. A Motorola employe since 1956, Gunter was formerly an industrial communications representative in the South. In his new capacity, he will supervise the sale of microwave equipment, working out of Dallas.

W. M. Creasy is named manager

. . . of Lummus Co.'s New York division. He is a company vice president. Meanwhile, Dr. S. Z. Avedikian joined Lummus as acting director of the Engineering Development Center in Newark, succeeding Creasy.

Previous to joining Lummus in 1958, Creasy was chief chemical officer of the U. S. Army, holding the rank of major general. Dr. Avedikian was co-founder of Avedikian & Co. in 1932, Tidings Corp. of America in 1947, and S. Z. Avedikian & Associates in 1959.

Oil Well Supply Division names

. . . a new field representative and a new store manager. John W. Mays will represent the U. S. Steel Corp. division in Houston, according to

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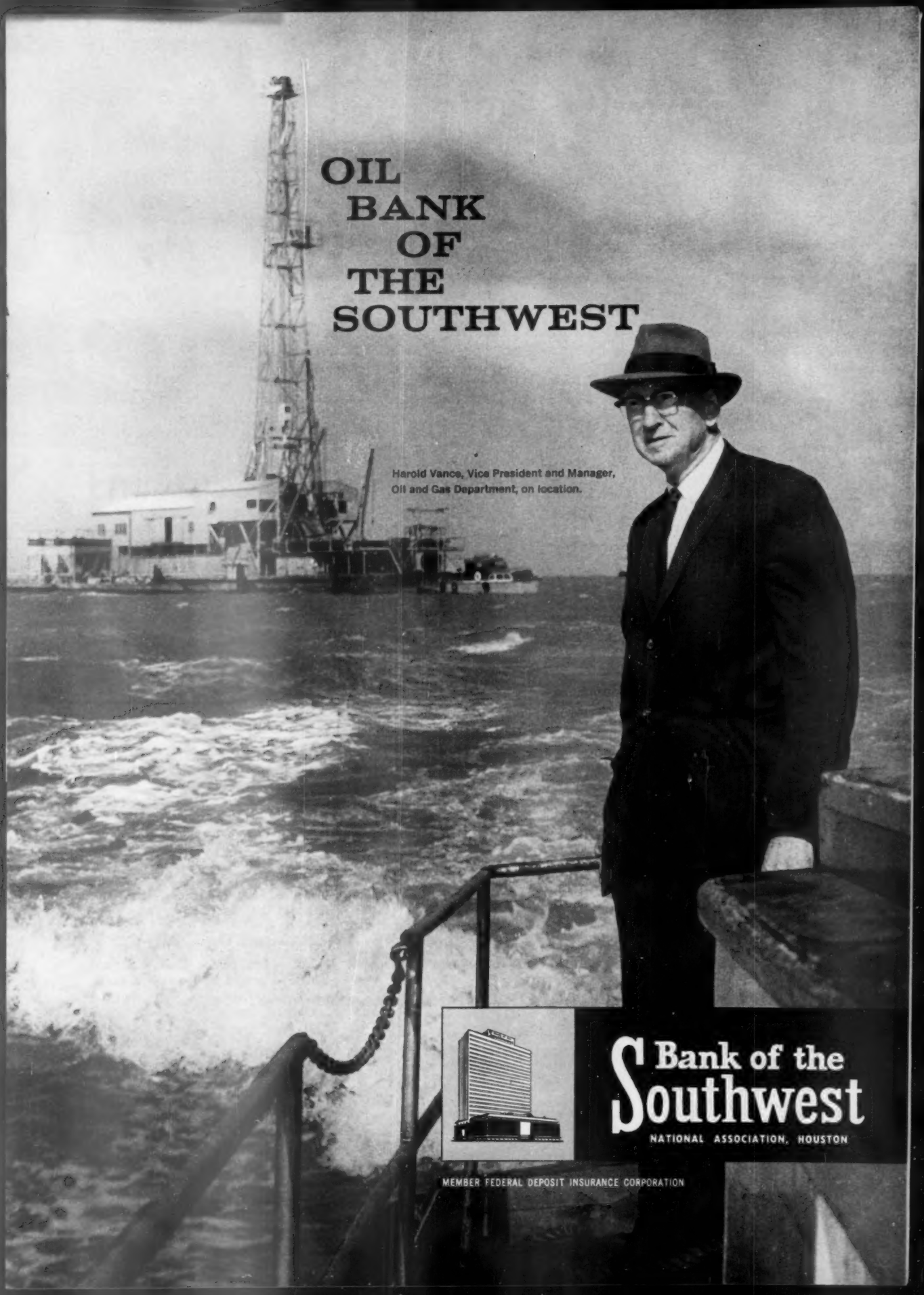
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M. F. Jones, Gulf Coast area manager of the division. Mays was employed by Oilwell in 1946 at Houston. Three years later he was transferred to Beaumont and appointed store manager. He went back to Houston in June 1950.

John J. Boslet takes over as store manager at Greensburg, Ky., reports J. P. O'Toole, the division's Eastern area manager. Boslet joined the concern in 1955 at Charleston, W. Va. He was transferred to Greensburg last year.

Woods Hinrichs named manager

. . . of the newly formed exploration-services department at Fairchild Aerial Surveys, Inc. He will be assisted by William Kellogg, the department's chief geophysicist.

After joining Fairchild in 1948, Hinrichs was appointed sales engineer for geophysical sales. He next served as chief geologist for the geophysical sales department.

Kellogg first joined Fairchild in 1948 as a member of the airborne magnetometer department. Between 1949 and 1958 he did private-consultant work. Prior to his new job as chief geophysicist, he was a mining specialist in the geophysical sales department.

DRILCO OIL TOOLS, INC., holds its third annual regional sales meeting in Midland, Tex. Highlighting discussions were two new drilling tools—a hard-formation reamer cutter and shock sub—developed within the last year to improve rig efficiency. The 2-day session was held for 30 members of the Drilco staff representing most areas of the Mid-Continent.

Gulf Coast Tube Corp. to install

. . . a new 1,800-ton extrusion press in its plant at Rosenberg, Tex. With this, production capacity of seamless-alloy-steel macaroni tubing and pressure pipe is expected to be increased in the area by 40,000 tons.

William A. McHattie, president of the corporation, said the shipment of machinery from West Germany consisted of parts for the most modern mechanical vertical extrusion press available anywhere. It's the first completely automatic press of its size to be put into operation.

Tuboscope Co. appoints pair

Dick Feemster

. . . to its staff, according to J. W. Bozeman, president. Dick Feemster has been named Houston divisional manager. His new job will be to supervise sales, production, and job training in the area. Feemster was most recently a salesman in the Tulsa area.

H. A. (Bert) Deem has become sales representative in the Tulsa area. He formerly operated as a Tuboscope salesman in Oklahoma City.

Kenneth S. Bayless named v.p.

. . . in charge of sales of Cal-Metal Pipe Corp. of Louisiana, announces R. C. Stewart, executive vice president. Bayless, who joined the corporation last summer, moves up from assistant sales manager.

Meanwhile, Stewart announced that Leonard C. Wahlenmaier has been made manager of the firm's Midland area sales office. Wahlenmaier, active in the oil industry in the Midland-Odessa area for 13 years, just recently joined Cal-Metal.

Schlumberger reassigns five

. . . of its field personnel. R. R. Shourd, who had served as location manager at Wichita Falls, has been promoted to Pacific division sales manager.

B. M. Ray has moved to the company's Kansas division as senior sales engineer. He was previously location manager in Perryton, Tex. Succeeding Ray in Perryton is H. C. Thomason, who previously was senior sales engineer in the Kansas division.

R. D. Knapp and P. E. Sapaugh, former field engineers general, have been named sales engineers. Knapp will remain at Andrews, Tex., and Sapaugh at Tyler, Tex.

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Growth helps Denver firm foster international plans

IN A recent announcement, E. C. Dorroh, president of Tradewinds Exploration, Inc., of Denver, cited the benefits that would follow Tradewinds' acquisition of Warren-Bradshaw Drilling Co. of Tulsa.

Operating as a single company, duplication can be eliminated resulting in substantial reduction of overhead and generate more cash flow.

The company, with 26 rigs, has certain advantages in becoming a leading drilling contractor.

Management is undergoing major streamlining which should add both drilling and exploration operations, and officers are highly optimistic about the potential represented by Tradewinds' 45% ownership in the Timor concession.

Based upon recent geological data gained from the first two tests on Timor, approximately 450 miles north of Darwin, Australia, prospects of a major oil discovery are good. Favorable aspects of Timor included: Numerous oil seeps and gas seeps; geological conditions are similar to those of the producing island of Ceram located off the northwest tip of New Guinea; and a ready market awaits commercial production.

DRILLING RIG of Pool Well Service, Inc., of Kilgore, Tex., digs a 3,500-ft. oil well on M. E. Daniels property near Coleman, Tex. Five days of 24-hour operation were required for completion of this well. Drilling equipment is powered by an International U-450 engine, which has logged more than 10,000 hours in a 4-year period. International L-170 truck transports drilling gear and serves as drill platform.

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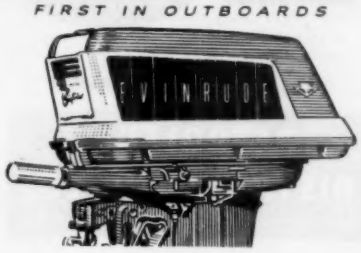

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Kansans spread east

A KANSAS DRILLING firm has formed an associated branch to drill in Kentucky. Brunson-Spines, Inc., of Wichita, has purchased a Mayhew 2000 which they shipped to Kentucky late in February. Equipped with a LeRoi 550 c.f.m. compressor, the rig can either use conventional mud or air drilling.

Brunson - Spines - Young - Mac has been formed as a division of the parent company and will run the new rig out of Franklin, Ky. under the direction of E. B. Young, manager of drilling and production. The new tool will be initially engaged in drilling 20 exploratory holes in Logan, Simpson, and Warren counties. Some will vary in depth from 1,100 to 1,200 ft., and will be drilled in 5 days each. In addition to these, there will be some holes drilled in the 500 to 600-ft. range and these are estimated at 3 days each.

The firm will be primarily engaged in drilling these holes first, but later the company will take drilling contracts and consider drilling deals with other operators. The two-rig outfit has another rig working in Kansas where it annually drills 30 to 35 wells for its own firm. Members in Kansas include W. S. Brunson and Jack Spines, who office at 302 Union Center in Wichita.

Drilling statistics

Here's some more drilling data:

SOUTH TEXAS

FASHING, Atascosa-Karnes Counties.
Pay: Edwards lime, 10,350 ft.
Approx. cost of well: Flowing $180,000.
Cost averages: Footage price $3.95
Day: With pipe $9.50; without pipe $9.25

Normal Rig-Time Distribution

% on footage rate	59	Total days	45
% on day rate	41	Total bits	25

Casing Program

	O.d. (in.)	Casing seat (ft.)	Cement (sacks)
Surface	10¾	1,606	850
Oil string	7	10,860	225

Typical Mud Program

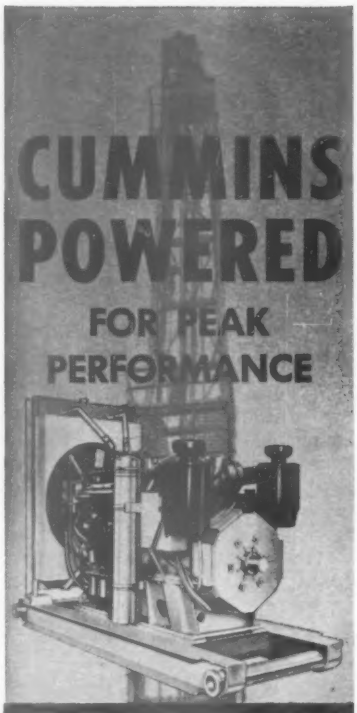
3,140 sacks material; $15,000 avg.

Avg. Formation Tops (Drlg. depth, ft.)

Edwards 10,350

Core Data

Edwards: Interval (ft.), 681; permeability (md.), 8.70; porosity (%), 13.04; residual oil sat. (%), 4.76; water sat. (%), 27.57; water drive, 1.6 M.M.c.f. per acre-ft., 18 bbl./M.M.c.f.



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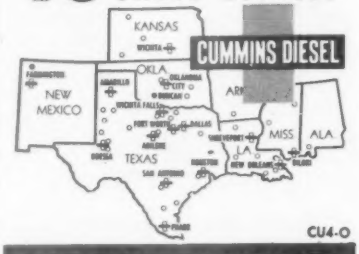
16 FACTORY-TYPE SERVICE SHOPS SALES OFFICES



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"Edward Mudwonder Valves keep our Investment down... efficiency up"

Lewis Yates, owner of the Yates Drilling Company, Lafayette, La., has proved to himself through his operating records that Edward Mudwonder valves are saving him real dollars. He says:

"Actual accounting records on our Rig #1 prove a point I have always believed to be true. The real savings on a mud valve is the money you don't have to spend to keep it in good operating condition. Checking the cost record for Mudwonder mud valves on our #1 rig showed that these valves have required the bare minimum investment in replacement parts. When such is the case, we can give top service to our customers without excessive investment in capital equipment and supplies.

"In short, Mudwonder valves help us keep our costs down due to less maintenance and less repair parts and, naturally, less down time."

The confidence Lewis Yates has in Mudwonder valves is found wherever you go in the drilling fields. Mudwonder valves are built to 2", 3" and 4" sizes, with screwed or flanged ends, for 2000 psi WP (4000 psi test), 3000 psi WP (6000 psi test) and in 2" size for 5000 psi WP (10,000 psi test) service. See your favorite oil field supply store, or write Edward Valves, Inc., 1212 W. 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company.

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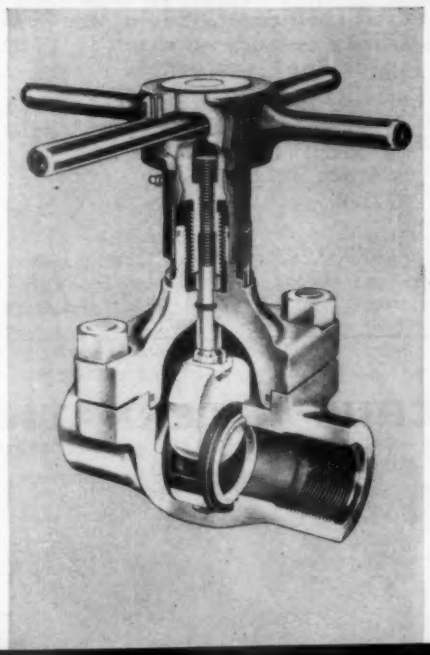
▲ Lewis Yates, owner of the Yates Drilling Company, has found from his own accounting records that Edward Mudwonder valves save him money in maintenance and down time costs.



◀ Mudwonder cut-away view shows the one-piece seat insert with Buna-N molded integrally over steel wear rings; chromed gate with "T" slot connection; separated stainless stem and double thread construction.

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Hoffman Oil Well Service Co.

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Gentlemen:

At the time the LeBus Spooling System, by the use of a cast iron machine grooved split sleeve, was installed on my swab drum I had operated the unit approximately five months. After the drum was grooved, I reversed ends of the line whereby I spooled the small end of the line onto the drum first. The line spooled very satisfactorily and the length of this particular line is 12,200 feet.

I have had this unit in constant operation for the past 20 months and due to the controlled spooling of the line I am still using the same line that was on the unit at the time the drum was grooved. The line is still in fair condition and I have no idea just how much more use I will get out of this particular line.

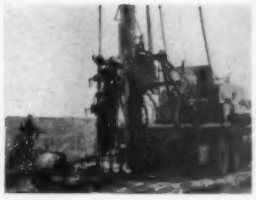
In using this one instance as an example, I feel that I have more than received my initial investment in the LeBus Spooling System due to the increased life of this one 9/16" line.

Another statement which I wish to make regarding the LeBus Spooling System is that it is not necessary for me to have one of my crew hand spool the line onto the drum when coming out of the hole. This, in my opinion, is a safety feature on which it is difficult to place a value in dollars and cents.

If you desire to use this information and myself as a reference to operators of well servicing units, you have my permission and you may inform any such operators to contact me either by letter or by telephone should they wish to confirm the above statements.

Yours very truly,

D. G. Hoffman



With wire line spooled on grooved drum unit is now ready for rigging up for swabbing job.

Twenty-sixth layer of 9/16" line — 12,200 feet. Note the perfect uniformity.

LEBUS

LEBUS INTERNATIONAL ENGINEERS
INCORPORATED
Longview, Texas

SOUTHERN MICHIGAN'S Scipio trend is awaiting the outcome of a wildcat well which, if successful, could stretch its limits 10 miles farther northwest. Kelly 1 Dunlap, arrowed here, could launch a new campaign into the counties north of those now involved in the play.

Michigan's Scipio trend takes northwest stride

BY FRANK J. GARDNER

IN THE SHORT space of 2½ years, southern Michigan has emerged as one of the top attractions for independent oil operators east of the Mississippi. Centered in three counties (Calhoun, Jackson, and Hillsdale), the play lies about midway between Chicago and Detroit.

At the beginning of 1957, there was no production in this area at all. Today, there are 133 oil wells along a 22-mile northwest-southeast trend, each producing an average 115-125 bbl. of 42° oil daily from Trenton-Black River (Ordovician) dolomite at 4,000 to 5,000 ft.

A porosity puzzle . . . But finding this oil hasn't been easy. Here is one of the most frustrating reservoirs now being explored anywhere in the country. It's a hit-and-miss deal. For production depends on spotting the fractured zones within the dolomite pay. Structure apparently has no effect.

The producing horizon is a secondary dolomite, tightly folded and fractured; at no point is the pay width greater than 1 mile. Producing wells are structurally low to dry outposts. And it's not uncommon to see "over the fence" offsets to flush wells end up as dusters.

May leap northwest . . . So far, activity has clustered about three main pools . . . Scipio, Pulaski, and Albion (see map). Scipio was the first found in 1957, and it is now a 66-well oil patch. Albion, a townsite pool, has 41 wells, and Pulaski 24.

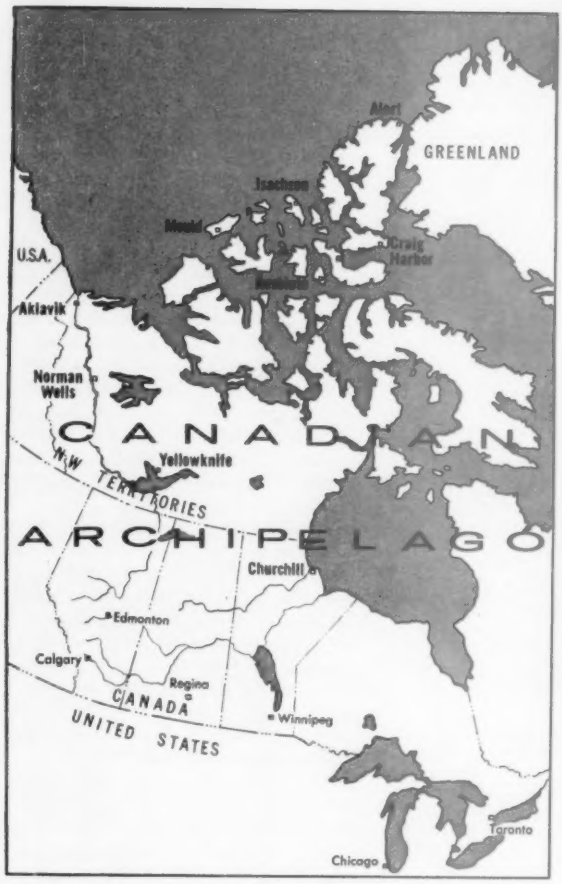
Today, it appears that the trend is in for a whopping 10-mile jump to the northwest. In northeastern Calhoun County, in Section 22-1s-5w (Lee Township), James O. Kelly and Sun Oil Co. 1 Dunlap shows every sign of coming in as a commercial well. After topping the Trenton at 4,226 ft., Kelly ran a drill-stem test at 4,414-74 ft. and had a gas flow rated at 5,200 M.c.f. per day. Oil failed to flow on the test, but samples at 4,460-74 ft. showed oil-saturated dolomite. Drilling has been resumed and the outcome should be known shortly. Operators usually complete deep into oil zone after acidization or fracturing.

And spill across the line . . . This Scipio trend has wrenched Michigan out of the oil doldrums and it's much more than likely that the coming spring and summer months will see an unprecedented drilling campaign throughout these southern counties. If the Kelly well makes good, don't be surprised if the play spills farther northwest into Eaton County and southeastward over into Ohio.

As with most strat-trap fields, Scipio might never have been discovered except for the dogged determination of a do-or-die wildcatter who wouldn't give up. C. A. Perry had no technical basis for the original location of his 1 Houseknecht, but he had that all-important hunch. He spudded his well in May 1955 and for a year and a half, it was on-again, off-again drilling. Finally, in January 1957, he hit the pay and finished Scipio's first well at 3,576 ft. It was rated at 800 bbl. per day, but the official potential read 150 bbl. on restricted flow.

At the time, nobody paid much attention, but in September of the same year, when Aurora Gasoline Co. and McClure Oil Co. had a 2,400-bbl. per day blowout at the 1 Stevens, fourth well for the field, the industry sat straight up. Since then, it's been a game of geologic hopscotch in an effort to ferret out the pay. With a ready market at $2.95 per barrel, reserves of 8,000 to 10,000 bbl. per acre, and well costs ranging $55,000 to $70,000 completed, the game has been worth while.

They say the Scipio discovery well was drilled partly on the advice of a fortune teller. If this is true, then perhaps we've found the answer to the riddle of nosing out strat traps. Geologists are notorious gypsies, but fortune tellers? Hardly.



FAR NORTH is new hunting ground for oil men.

A GEOLOGIST traversing Bathurst Island in the Canadian Archi-

How geologists hunt for

BY W. B. GALLUP
Gallup, Buckland, & Farney, Ltd.

While recent events associated with preliminary industrial development in the Canadian Archipelago tend to give the impression that the Arctic is an absolutely new frontier, this is not actually the case.

Geographical exploration of these islands was virtually accomplished a century ago as a result of the search for a Northwest Passage from Great Britain to the Orient.

While this search was eventually successful in that such a passage was found, it was also recognized before its discovery that such a passage when found would have no practical use. Assaults were made from the Pacific via the Bering and Beaufort Sea, from the Atlantic via Baffin Bay and Davis Strait, and overland via the McKenzie River system where over a century ago the fur trade had developed a chain of forts connected by canoe and dog team.

From the overland approaches, the top of the continent was mapped. At approximately the same time, sailing vessels of the Royal Navy mapped the islands and bays and straits of the archipelago itself. Great impetus was given to this stage of the exploration and mapping by the disappearance of the Franklin party in the 1840's which resulted in a number of vessels being sent out from England by the Royal Navy during the 1850's. Franklin's fate was finally determined and the search which solved it at the same time achieved the mapping of the archipelago.

Following this activity on the part of the Royal Navy, the archipelago had relatively few visitors aside from occasional mounted-police patrols and explorer scientists such as Parry and Amundsen and their groups. Much of the area is beyond the northern habitat of the modern Eskimo and consequently the fur trade never developed northward beyond those islands immediately adjacent to the continent. The map shows the general physiography of the islands and the main bases now established. The establishment of these bases occurred during the late 1940's with the construction of the Dew Line (Defense Early Warning) generally along the northern edge of the continent and the establishment of weather stations in

pelago notices that the regolith is Middle Devonian carbonate, virtually in place.

oil in the far north

the outlying islands, the most northerly of which is Alert.

The main base for these weather stations is Resolute Bay on Cornwallis Island, from which supplies are flown to the satellite stations. The supplies are generally transported to Resolute Bay from Montreal in August. Scheduled flights from Churchill are made every 2 weeks by the RCAF and there are numerous unscheduled flights from Edmonton and eastern Canada for purposes of resupply.

The establishment of these bases and their maintenance and operation is jointly undertaken by the United States and Canadian military who, in effect, afford the transportation facilities to maintain the weather bases which are jointly operated by the Canadian Department of Transport and the United States Weather Bureau. Numerous minor explorations are undertaken each summer under the sponsorship of universities and other organizations in Canada and the United States. During the 1940's, the Royal Canadian Air Force made aerial photographs of the archipelago and it was this aerial mapping and the presence of bases in the area which made possible the Geological Survey of Canada mapping projects which are still going on and which have been highly successful.

General Geology and Mapping Procedures

Orogenically the islands are comprised of a number of fold belts which involve sediments ranging in age from Cambrian to Tertiary. The total section over-all is about 80,000 ft. The sedimentary basin is bounded on the north by the Arctic Ocean and on the south by the Canadian shield. The sediments onlap on the shield on the southern islands of the archipelago and peninsulas such as Boothia jutting out from the mainland. Generally speaking, the sedimentary section will not be thick on islands south of a line running from Lancaster Sound to Viscount Melville Sound.

In the Parry Islands fold belt which occupies the southern portion of the Queen Elizabeth Islands, a sequence of rocks ranging in age from Ordovician to Upper Devonian is folded into a series of anticlines and synclines striking almost due east and west from the eastern side of Bathurst to the western end of Melville.

THE AUTHOR, W. B. Gallup, finds working conditions in the Far North very different from those faced by most oil men. The long summer days, for instance, permit almost continuous activity, since there are no lighting problems. As an example, the author at left poses with a group of muskox skulls for a picture taken at midnight. The light permitted an exposure of f8, 1/50 second. Gallup is consulting geologist with the firm of Gallup, Buckland, & Farney, Ltd., Calgary. He is a native of Saskatchewan and a graduate of the University of Saskatchewan. He has worked for Anglo-Canadian Oil Co., Ltd., Home Oil Co., Ltd., and the Oil & Gas Conservation Board of Alberta. In 1942, he joined Royalite Oil Co., Ltd., as resident geologist in Turner Valley field; he later became chief geologist for Royalite, and left that company in January 1956 to organize the consulting firm.

This fold belt is tilted upwards to the east as it approaches Cornwallis Island which is, in effect, an extension of the Boothia arch. East of Cornwallis Island the sedimentary section onlaps on the Canadian shield about the center of Devon Island. North of the Parry Island fold belt the structure is much more complex. There is some faulting and salt domes are common. Rocks exposed at surface between the Parry Island fold belt and the Arctic sea are, generally speaking, Mesozoic clastics which provide an excellent cover for the thick sequence of Paleozoics exposed in the Parry Island fold belt. Evidence of petroleum such as petroliferous odors, pyrobitumen and oil staining are quite common in outcrops in the Paleozoics of the Parry Island fold belts.

Biostromal and biohermal facies occur commonly so that both source and reservoir requirements may be generally considered as satisfied in the Paleozoic sequences. However, field work should include comprehensive stratigraphic studies as well as structural mapping. The area is not generally glaciated except in the eastern and northeastern islands and there is practically no soil so that all rock at surface is virtually outcrop although good outcrops such as those which might be used for detailed measuring of sections, etc., are not common and occur usually in stream canyons or on cliffs such as those along the edge of the sea. However, for practical mapping purposes, the outcrop is continuous in that the regolith is virtually in place and formation boundaries can be readily recognized both on the ground and from the air. Dips are taken from good outcrops in the stream cuts, on cliff facies, or from lineations on hillsides which may be measured from a distance. The magnetic compass is useless, so strikes must be plotted on photographs. Aerial views of the Parry Island fold belt show the general nature of the outcrop and indicate the ease with which geological mapping can be undertaken.

During actual field operations, light airplanes with large tires are used for transportation. A two-man geological party will use two aircraft and the days' work consist of flying and landing; mapping formation boundaries and dips and strikes on the photographs; measuring and describing sections in detail where outcrops exist, thus compiling all available geological data. Due to the prairielike nature of the terrain, the aircraft can land virtually anywhere and the operation is very much like that undertaken by helicopters in other areas at a much lower cost.

As a result of the splendid adaptability of the photographs, the ease with which the geology may be mapped in detail using the airplanes the coverage is phenomenal. For example, the two-man party supplied to Round Valley Oil Co. of Calgary by Gallup, Buckland, & Farney, Ltd., mapped in considerable detail approximately three million acres on Cornwallis, Bathurst, and Melville during the field season of 1959; the field season opens shortly after the middle of June and continues to early September when snow flurries and fog make the operation impractical.

During the summer our two aircraft made about 575 landings apiece away from camp. Our men lived in tents. Cooking was done on Coleman stoves. The food was mainly canned and dehydrated supplies which had been taken in last winter. Supplies may be taken in to any of the Air Force bases by transport planes such as Bristols, DC-4's, and similar aircraft from Yellowknife or from Churchill, at any season. Yellowknife is by far the most satisfactory. These supplies consist of gasoline, food, and camping equipment. They may also be laid down at Resolute via boat from Montreal each August. From whatever base the supplies are landed, caches may be established in any part of the archipelago by light aircraft—on skis in winter or on large tires in summer.

The total cost of a summer's

A CACHE of supplies is shown here at Cameron Lake, Bathurst Island. This cache was established for the firm of Gallup, Buckland, & Farney.

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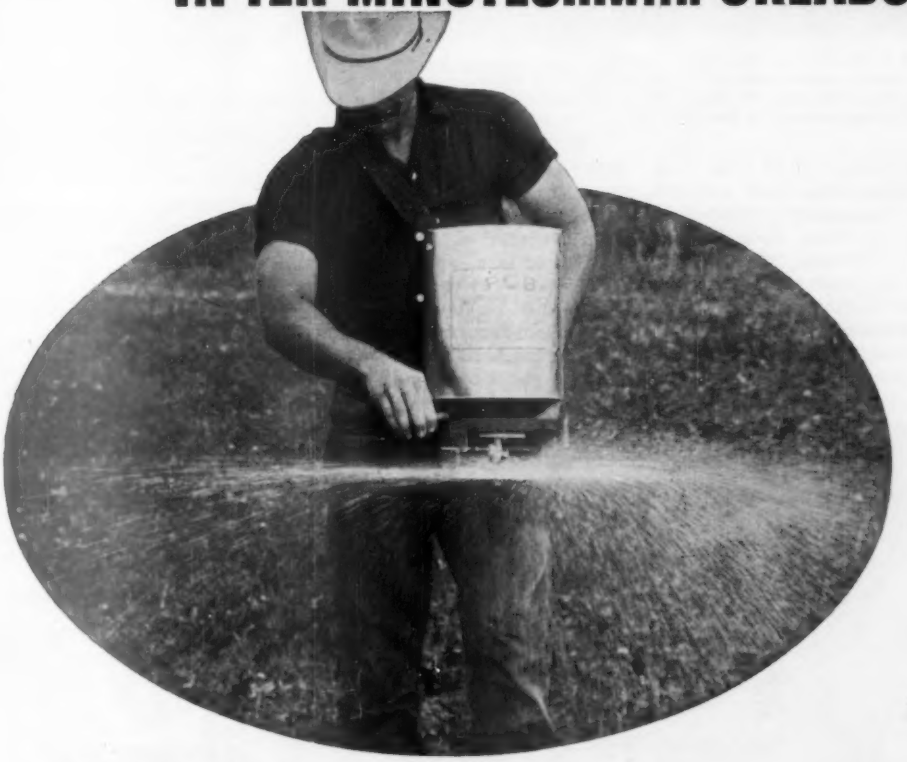

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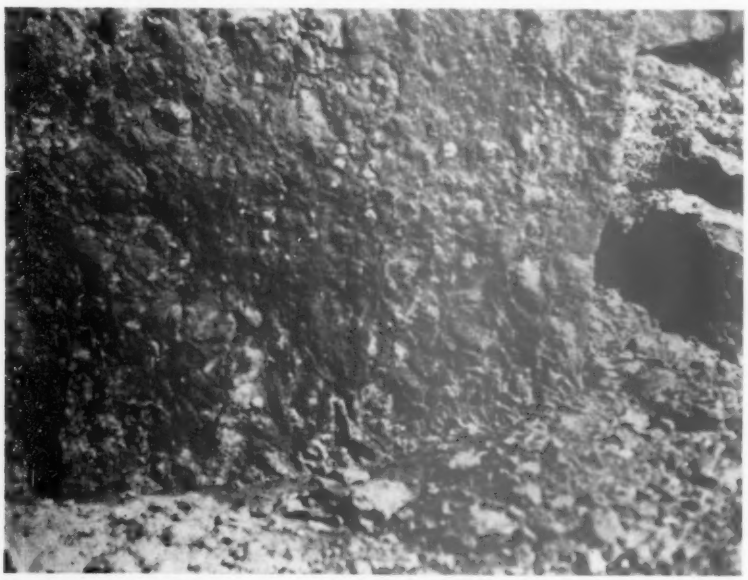
LARGE TIRES on Piper Cub facilitates landing on almost any terrain. In the foreground is a cairn established by Sir John Austin, R.N.,, over a century ago, in 1852, when England sent its Royal Navy to search the area for the Franklin party, which disappeared in the 1840's.

mapping with coverage of from 2 to 4 million acres, costs from $40,000 to $60,000, depending generally on the amount of flying done by the light planes. Whether supplies are taken in by air from Yellowknife or by boat from Montreal does not make any material difference in the over-all cost. For example, food, gasoline, and personnel can be transported from Yellowknife to Resolute Bay for from $8,000 to $10,000, including the cost of the supplies, whereas about one-half that sum of money would be required to take supplies from Montreal by boat and the personnel would still have to be flown in.

It should be recognized that the costs quoted here are generalized and are only intended to indicate the degree of ease and efficiency with which gelogical mapping in the area may be undertaken.



FOSSILIFEROUS Middle Devonian, Blue Fiord limestones.

ON BATHURST ISLAND, these tents were used at the Gallup, Buckland, & Farney camp. The tents were naturally white, but this picture was taken while they were being treated with a preservative, which darkened them.

Climate

The climate of the Canadian archipelago is generally dry although it is not arid due to low temperatures and considerable cloudiness. There is not much snow in the winter and the temperatures are not as low as those on the continent such as northeastern British Columbia or the Yukon Territory. There is, of course, considerable wind and the darkness from November through January would, to a degree, place some burden on operations such as drilling which would be expected to continue the year around. This applies also for mainland areas of the western Arctic or sub-Arctic where drilling is now being undertaken and the cold is much more severe.

In summer, the climate is actually pleasant with long periods of sunny skies which are interspersed with shorter periods of low cloud with some wind. There are practically no flies and it is our experience that the prairies of the Arctic Islands are generally a pleasanter and easier place to do geological mapping than most areas within our experience.

Accessibility

Accessibility is already established from Edmonton, Yellowknife, and Churchill by air, and from Montreal by boat. In fact, scheduled flights by Pacific Western Airlines originating in Edmonton now go to Cambridge Bay and other points in the western Arctic. Other airline companies are closely watching developments in the islands preparatory to applying for franchise to Resolute. As stated above, light aircraft with large tires or on skis, can be landed practically anywhere except, of course, in mountainous regions and there are many places such as lakes and level plains where DC-3's can land and take off on skis and wheels.

The establishment of strip operation all year around to DC-3's is readily possible through the use of light tractors which may be transported in the DC-3's themselves. Once such a strip is established, facilities can be developed to accommodate any type of large aircraft so that it is readily possible to plan on shipping in any equipment that can be airborne.

Many of the islands may be reached annually by boat and there are numerous deep-water harbors where beach landings effected by lighters may be achieved. Movement of any type of drilling equipment over any

THESE MUSKOX, at the base of an uphill slope in Central Bathurst Island, have been disturbed and are instinctively forming a defensive square, with which they can defend themselves from all directions.

of the islands other than mountainous and glaciated regions should be no more difficult than similar movement on the prairies of Saskatchewan or Dakota. Such development will, no doubt, be undertaken by the industry as it is in other parts of northern Canada before long and the Department of Transport is considering the establishment of other facilities.

Tracked vehicles can travel with ease on any of the islands in almost any season while jeeps, land rovers, and power wagons can be driven almost anywhere in the summer and—to a degree—in the winter without preparation of roads. Eskimo dogs are available for transportation of supplies at Resolute. This sounds primitive, but these people will undertake it on a tonnage basis and could be most useful for the establishment of minor food and gasoline caches in the winter time.

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Paluxy discovery is confirmed in Texas

Discovery last September of Paluxy oil production 6 miles northeast of Tyler, in central Smith County, Texas, is just now being confirmed by the new field's third test.

Both wells were drilled by Delta Drilling Co. The new producer, 1-A Howard, southwest offset to the discovery well, 1 Prejean, is pumping 171 bbl. of 30.2°-gravity oil daily with pay at 7,215-43 ft.

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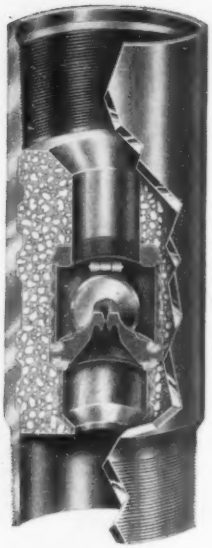

Filrite Float Collar
Fig. 451

FILRITE EQUIPMENT was designed to allow automatic filling of the casing while it is being run and to eliminate pressure surges which might break down weaker formations.

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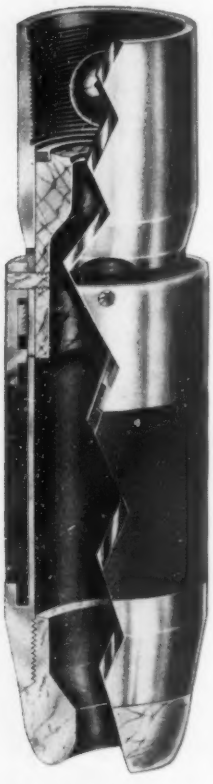
Filrite Equipment contains a resilient diaphragm valve which prevents entrance of well fluid into the casing until several joints have been run. When fluid pressure from below overcomes the inherent resistance of the valve to open, the valve then opens and allows partial fill of the casing without overflow. This type of fill-up is continuous until casing is landed.

The Cementrol Guide Shoe serves as a guide until casing is landed. A bridging ball is then dropped and by pump pressure from the surface the Cementrol packing element is expanded against the wall of the hole and no cement can contact the producing zone.

For additional details on Filrite and Cementrol please refer to your Larkin catalog—or call your nearby Larkin representative.



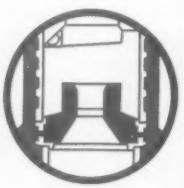
Cementrol Guide Shoe
Fig. 227

A

Circle A, a view 90° from that of the large illustration, shows the Filrite valve in running-in position. The resilient diaphragm valve remains closed until the differential fluid pressure across it overcomes its inherent resistance to open.

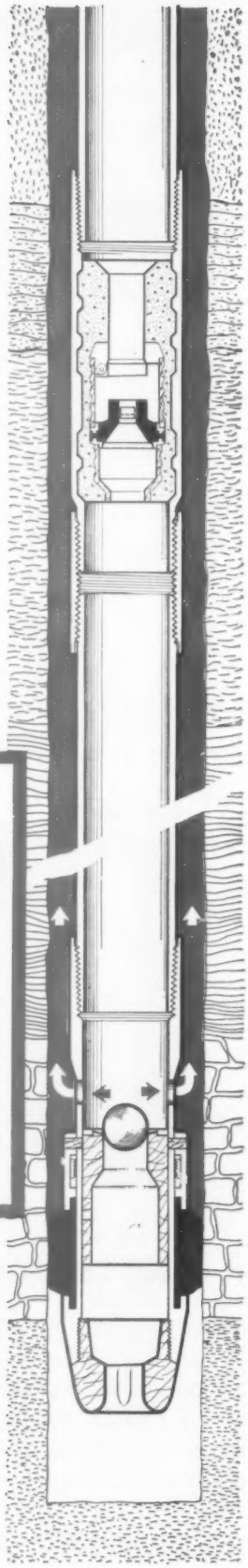
B

Circle B shows the rubber diaphragm inverted by pump pressure as the well is being cemented. Filrite is full opening and will allow passage of a bridging ball to actuate other equipment which might be installed on the casing beneath a Filrite Collar.



C

Circle C shows the spring-loaded flapper valve in closed position after being released by inversion of the diaphragm. The flapper valve in the Larkin Filrite equipment is very strong and has no depth limitations.



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Record Quartz pay flows at Alberta well

The thickest net pay zone yet found in Alberta's Basal Quartz horizon is reported at a Texaco-Honolulu-Pacific well in the Gilby area of central Alberta.

The well was completed flowing 13,100 M.c.f.d. of wet gas from 132 ft. of net pay. Location of the 6-16 Gilbey is on LSD 6, 16-41-3w5.

Illinois field adds another producer

IN CLAY COUNTY, Illinois, Francis M. Pierce 1 R. Wattles-T on the Wood Unit in SW SE NE 1-4n-7e, became the fourth producer in a fast-growing area 3 miles north of Sailor Springs.

The well recovered 1,035 ft. of clean oil on a drill-stem test at 2,896-2,915 ft. in McClosky Mississippian lime. The discovery well of this new area was completed in December by Francis M. Pierce at 1 Earl Stanley in NE NW SE 1-4n-7e. It flowed natural 1,250 bbl. of oil the first day from McClosky at 2,911-15 ft.; after being on pump it made 200 bbl. per day at 2,922-27 ft. The 1 Crouse et al. in S½ SW NE 1-4n-7e, flowed 476 bbl. per day on ½-in. choke from McClosky at 2,904-12 ft.

Deep play. Illinois' deep play continues in Hamilton and Edwards counties. Mt. Carmel Drilling Co. 1 Thomas et al. Unit, NE NW SE 11-4s-7e. This old well worked over will go to Devonian. Old total depth is 3,495 ft.

In Edwards County, Crystal Oil Co. will deepen the 1 Broster Heirs in SE SE NW 33-1s-14w from 3,052 ft. to Devonian. This deep test is 3 miles east of Albion.

California well recompleted in deeper pay zone

The Pleito Ranch field discovery, Kern County, has been recompleted by Shell Oil Co. in a deeper zone as a new pool wildcat. In September 1957, Shell brought in the well, 48-25 KCL, as a new field find flowing 105 bbl. daily of 22.8°-gravity crude from selectivity perforated intervals between 11,588 and 11,674 ft. Last month, Shell moved back into the 15,177-ft. test and reperforated it at 12,496-12,520 ft. as a new pool discovery making 234 bbl. daily on the pump.

Belgian anticline extension comes in big

A northeast offset to a January extension of the main area of the Belgian anticline field in Kern County was completed by Shell Oil Co. for an initial flowing rate of 438 bbl. of crude through a 16/64-in. choke. The well, 37-14 PML, was perforated at 6,254-74 ft. while the well it offsets was perforated at 5,670-80 ft. Both wells are in SE SW 14-30s-21e.

Wheeler Ridge extended in California

Richfield Oil Corp. extended production two locations west of the nearest well in the Windgap area of Wheeler Ridge field with a test in NE SE 35-11n-20w. The well, 85-35 KCL L, was completed in an interval at 5,525-5,678 ft. flowing 234 bbl. daily of 20°-gravity crude through a 1¼-in. choke.

Ohio test flows oil

In Ohio's Perry Township, Licking County, Carl Smith sunk a Clinton test in the Tilton Berea pool that produced a flow of 100 bbl. oil per day

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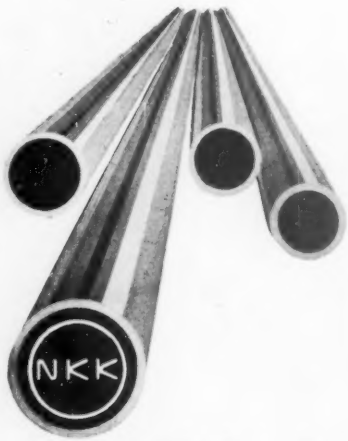

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after fracture. Natural gage of 12 Fee, Section 2, was 35 bbl. of oil and a show of gas. The Clinton sand was found at 3,004-19 ft. and 3,025-49 ft.

The operator has three other wells drilling in the area, one of which is now being fractured.

Ohio's Coshocton adds two more successes

Newcastle pool in Coshocton County, Ohio, gained two more successes as northern extensions in Tiverton Township were reported completed.

Natol Corp. 1 J. S. Conner, Section 20, logged the Clinton sand at 3,260-97 ft. and gaged 26 bbl. oil per day in a 24-hour test after fracture. Dalton and Hanna 2 J. Bowers, Section 20, an offset to its 600-bbl. producer, logged the Clinton sand at 3,161-3,213 ft. and made 50 bbl. oil in a 24-hour test after fracture. In the same area, 4 E. Gamertsfelder, Section 22, logged the sand at 3,180-86 and 3,210-19 ft. but was plugged when no increase of gas or oil was evidenced after fracture. Natural production was 184 M.c.f.d.

Potential released on New Mexico discovery

Initial potential at Gulf Oil Corp. 1 Nye Federal, a Graneros discovery in San Juan County, San Juan basin, northwestern New Mexico, was 186 bbl. per day on pump.

Production is from a casing notch at 6,320 ft. The well is in NE SE 24-25n-9w, 2¼ miles southwest of Western Natural Gas Co. 1 Stephenson, a recent oil strike.

New exploration slated for N.M.

SOUTHEASTERN New Mexico's Guadalupe Mountains are due more exploration. This southwestern Eddy County region has several new wildcat locations in the mill.

Humble Oil & Refining Co. will drill 4 Huapache Unit in SW SW 14-24s-22e, 29 miles southwest of Carlsbad, 1 mile east of the 3 Huapache, a 8,670-ft. dry hole of last year. That well went to Devonian.

Humble's well may find Abo reef at the new well. Location is 9½ miles southwest of Humble's Pennsylvanian discovery at Bandana Point Unit last year. It also lies 16¾ miles northeast of E. P. Campbell 1 Spiegel, a drilling well in Otero County.

Gulf. Gulf Oil Corp. is working at 1 North Caverns Unit in NW SW 11-23s-24e, halfway between Humble's above well and Carlsbad. This well will go to 11,750 ft. or Devonian. It lies 12 miles northwest of Gulf 1-AD Estill, a tight hole that is reportedly a Pennsylvanian gas strike.

New Mexico wildcat tests Morrow pay

RARE Morrow production is being tested at a wildcat on the West Tonto Unit in Lea County, southeastern New Mexico, 13 miles south of Maljamar. It is Pan American Petroleum Corp. 1 West Tonto Unit in 18-19s-33e, 3½ miles northwest of Tonto field and 3½ miles southwest of Buffalo field.

On latest gage the Pennsylvanian gasser flowed 3,281 M.c.f.d., stabilizing to 2,180 M.c.f.d. after 1 hour. Condensate flow was 74.4 bbl. per day on 48/64-in. choke. Perforations were at 13,325-78 ft., making it one of the deepest producing areas in New Mexico.

Reeves wildcat hits Devonian oil in New Mexico

Southeastern New Mexico's Reeves area, central Lea County, has a Devonian discovery at John M. Kelly 1-SS Federal, NW NW 24-18s-35e, 15 miles west of Hobbs. The well flowed at the hourly rate of 10 bbl. of oil on drill-stem test at 12,100-12,200 ft. Flow was through ½-in. choke.

The well was projected to Pennsylvanian, but finding nothing went on to Devonian. Location is ¾ mile southeast of two producers in Reeves Pennsylvanian field. Nearest Devonian oil is Pure Oil Co. 2-F State, 1¾ miles southwest. That well flowed 600 bbl. daily on 11/64-in. choke on a recent completion test.

San Juan well flows oil from Gallup zone

A good Gallup Cretaceous oiler for northwestern New Mexico's San Juan basin is Dorfman production Co. 1 Judy, a northwest extension to Escrito Gallup field. The Rio Arriba County well flowed 552 bbl. per day.

Perforations were between 6,110 and 6,138 ft. Flow was on ¾-in. choke. Location is SE SE 17-24n-7w, 6 miles north of Lybrook. It is a direct west offset success to Compass Exploration Inc. 1-16 State. That well flowed 480 bbl. daily. There are a dozen wells in this field, but the 1 Judy appears to be the best so far.

Closely watched gas test abandoned in California

One of California's most closely watched natural-gas wildcats has been abandoned after earlier encouraging shows failed to prove out. The well was McCulloch Oil Exploration Co. of California's 1 McCulloch-Sunray-Stevenson in Tehama County only 9 miles south of Red Bluff.

Enroute to its total depth of 5,384 ft., the well reportedly encountered both oil and gas shows at 4,900 ft. in the Cretaceous. If successful, this well would have ranked as the San Joaquin Valley's most northerly producer.

Well completed in Eastern Kentucky's Breathitt County

A good well in the Highland pool of western Breathitt County has been completed as Preston Oil pumped 140 bbl. of oil daily from 1636 Jett located in the Jackson quadrangle. Producing formation is the Corniferous lime topped at 1,945 ft. and penetrated to 1,987 ft. total depth. Well was given a 2,000-gal. hot acid-fracturing treatment.

Details released on Arkoma basin wildcat

One of the most important wildcats ever drilled in southeastern Oklahoma is Midwest Oil Corp. 1 Raymond F. Orr in 8-6n-22e, Latimer County. The company recently released all details on this well. The deep test went to 12,650 ft. A 5-in. liner was run from 10,675 to 11,680 ft. Tops are as follows:

Booch sand 490-576 ft., Hartshorne 1,540-1,782 ft., gas sands (shows) from 3,440-6,339 ft., Red Oak (Lower Atoka) from 7,191-7,335 ft. This sand gaged 17.5 M.M.c.f.d. through 2-in. opening meter at 7,307 ft. The hole was drilled to this point with air. Sand with a show of gas from 7,917-57 ft., Spiro sand (good shows of gas) from 11,508-84 ft., Wapanucka lime 11,644-11,754 ft., Cromwell sand 12,072-12,158 ft. (hard and tight with no show). Perforations 11,514-37, 11,558-68 ft. A drill-stem test from 11,514-68 ft. with packer set in casing at 11,460 ft. TP 2,200 psi. ¼-in. choke. Gaged 2.2 M.M.c.f.d. Shut in 1 hour and 20 minutes on the surface. Tubing pressure increased from 2,200 psi. to 3,625 psi.

On two-point back-pressure test, calculated open flow was 5.3 M.M.c.f.d. IBHFP 1,520 psi. 90-min. BHSIP 4,695 psi., still rising. Fractured from 11,514-37 ft. with 40,000 lb. sand. Average injection rate 21 bbl. per minute. Set plug at 11,410 and perforated 7,327-30 ft. with water in the hole. Well began kicking. The well had a maximum of 1,000-psi. surface pressure. Operator brought the well under control. Preparing to continue perforating from 7,191-7,327 ft.

Anadarko gets Horton discovery

NORTHWESTERN OKLAHOMA apparently has another Hunton Siluro-Devonian discovery, one of four such producers in the entire northwestern Anadarko basin from this pay zone.

Statex Petroleum Co. 1 Weaver, C NE SW 28-27n-21w, Harper County wildcat northwest of Lovedale, got 3,300 ft. of oil on a drill-stem test at 7,290-7,316 ft. Another test at 7,290-7,316 ft. flowed gas at 176 M.c.f.d. Later it flowed 46 bbl. per hour maximum, falling to 1 bbl. per hour in 5 hours. Recovery was 6,180 ft. of oil and 120 ft. heavily oil and gas-cut mud.

The 1 Bennett in C NW SE 29-27n-21w was flowing 768 M.c.f.d. from Hunton at 7,233-45 ft. Fluid flowed 2 bbl. hourly, a fourth of it oil.

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or the hazard of

STICKING

drill pipe and casing

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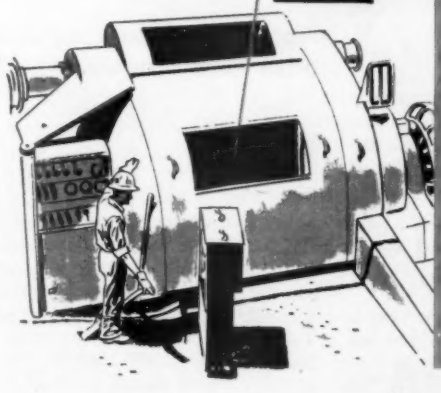

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	DUAL	TRIPLE
Arkansas	3	...
Kansas	4	...
Louisiana, offshore	6	1
Louisiana, south	2	1
New Mexico, Southeast	7	...
New Mexico, Northwest	5	...
Oklahoma	20	1
Texas	27	2
District 2	2	...
District 3	5	...
District 4	1	1
East Texas (5 & 6)	2	...
West (7-C & 8)	12	1
District 9	1	...
District 10	4	...
Wyoming	1	...
Total United States	75	5

Note: January figures appeared February 15, p. 168 in The Oil and Gas Journal.

Hunton pool opens in Central Oklahoma area

Hunton Siluro-Devonian lime production is reported at a wildcat in Pottawatomie County, Central Oklahoma. The discovery well, west of Morvin field and northwest of Burnett field, is Ashland Oil & Refining Co. 1 Stovall in C SE NE 5-8n-2e.

Flow was 210 bbl. of new oil in 12 hours on ¼-in. choke from 5,138-52 ft. Offset try has already begun at 2 Wells in C SW NW 4.

OU golf course to see wildcat action

The golf course at the University of Oklahoma, Norman, will get a wildcat. Petroleum Inc. will drill 1 Boyd in NE 5-8n-2w, Cleveland County, as a directional hole underneath the golf course southeast of the campus. Objective will be Oil Creek Ordovician sands. It may go to Arbuckle. Location is on the Boyd dairy farm. The wildcat will be on land recently bought at the Oklahoma University Board of Regents land sale held February 17. Petroleum Inc. bought 73.85 acres in SE SW 32-9n-2w and NE NW 5-8n-2w.

New gas find reported in Arkoma basin area

Southeastern Oklahoma's portion of the two-state Arkoma basin has another gas discovery. Bell Oil & Gas Co. completed 1 Young in SE NE 11-11n-18e, southwest of Warner gas field in McIntosh County, for 1,040 M.c.f.d. from perforations at 902-912 and 931-941 ft. in Pennsylvanian. Arbuckle was topped at 2,328 ft. Basal Atoka was topped at 1,060 ft. Gas zone was at 902-912 and 935-946 ft.

Other news. Apache Oil Corp. 1 Williams in C NW 14-8n-19e, a new gas discovery in Haskell County, west of Kinta field, flowed 5 M.M.c.f.d. through ¾-in. choke from perforations in basal Atoka Pennsylvanian at 5,682-5,714 ft.

Triple completion in Oklahoma's Laverne area

A three-zone producer was added to big Laverne gas district in northwestern Oklahoma's Harper County. The well is Sinclair Oil & Gas Co. 1 Gibson Unit in C SW NE 21-26n-24w.

Gas-condensation production was tapped in Hoover, Morrow, and Chester. The Hoover Pennsylvanian at 4,315-64 ft. flowed 10 bbl. condensate per day and 1,450 M.c.f.d. through 17/64-in. choke. The Morrow at 7,017-30 ft. got 10 bbl. of condensate in 12 hours on ¾-in. choke and 3,400 M.c.f.d. The Chester Mississippian was good for 18 bbl. condensate in 12 hours on ¾-in. choke and 3,972 M.c.f.d. from perforations at 7,091-7,135 ft.

Oklahoma's Kingfisher sets Manning offset

First offset to a new Manning Mississippian discovery in Oklahoma's booming Kingfisher County is Apache Oil Corp. 1 Sioux Unit in C NE SW 32-16n-7w. It will go to 8,200 ft.

The discovery well was completed at 1 Snow in 5-15n-7w, flowing 25,000 M.c.f.d. from Manning. Location is south of the town of Kingfisher.

Northwest Oklahoma pool adds third producer

North Linscott field in Ellis County, northwestern Oklahoma, now has three producers. Pan American Petroleum Corp. 3 Shattuck Operating Unit, C SW NE 2-22n-26w, 1 mile north of production in the field, flowed 256 bbl. of load water per day and 2,300 M.c.f.d. from perforations in the Morrow Pennsylvanian at 8,726-29, 8,819-22, and 8,860-63 ft. The discovery well of the pool is 1 Shattuck Operating Unit in 11-22n-26w. That well flowed 23,750 M.c.f.d. from Morrow at 9,088-94 ft. The second well was completed in Section 14.

Dewey County. Other northwestern Oklahoma news includes staking of a new well for West Valley Center field in Dewey County, 1 mile west of production.

The new start is Sunray Mid-Continent Oil Co. 1 Rein in C SW NE 16-17n-18w. It lies west of Sinclair Oil & Gas Co. 1 Collier in C NE NE 15-17n-18w, an Oswego Pennsylvanian producer at 9,178-98 ft. and Tonkawa at 7,527-60 ft. The 1 Collier recently flowed 656 M.c.f.d. and 11 bbl. condensate per day on 18/64-in. choke from the upper pay; 9,020 M.c.f.d. on 15/64-in. choke from the lime pay.

Sunray's well will be the third well in the field. Carter Oil Co. has a discovery 3 miles west of the 1 Rein attempt and is currently testing.

First strike of year completed in Paradox

A small Paradox Pennsylvanian oil discovery opens the first new pool in Paradox basin this year. Discovery well is Carter Division Of Humble Oil & Refining Co. 12 Bluff Bench Unit in San Juan County, SE SE 12-40s-21e, 2 miles north of Bluff, Utah.

The well pumped 47 bbl. of oil per day and 40 bbl. water daily. Perforations were at 5,660-66 ft. in the "B" zone of Paradox. Gravity is 41°. Location is 2 miles northwest Bluff Bench field.

South Dakota pool is confirmed

Shell Oil Co. completed 32-11A Seppala in SW NE 11-20n-4e, Harding County, as a confirmation to the 1959 discovery of the same firm at 1 Tilus in C SW NW 11-20n-4e. The South Dakota well pumped 53 bbl. oil and 60 bbl. water daily from Red River Ordovician through open hole at 8,331-38 ft. Location is ½ mile east of the 1 Tulus. That well pumped 111 bbl. of oil and 109 bbl. water per day from Red River.

Another well, the 34-2A Haivala in SW SE 2-20n-4e, ½ mile north of the confirmation, is being perforated for tests. Also at Buffalo, 4 miles north, Shell completed 32-8 State in SW NE 8-21n-4e for 42 bbl. of oil and 226 bbl. of water daily from Red River at 8,530-37 ft.

Southwest Jones County Canyon hit confirmed

A confirmation discovery to Canyon reef production in southeastern Jones County, West-Central Texas, is reported at Fletcher Oil & Gas Drilling Corp. 1 H. N. Smith. The flow-

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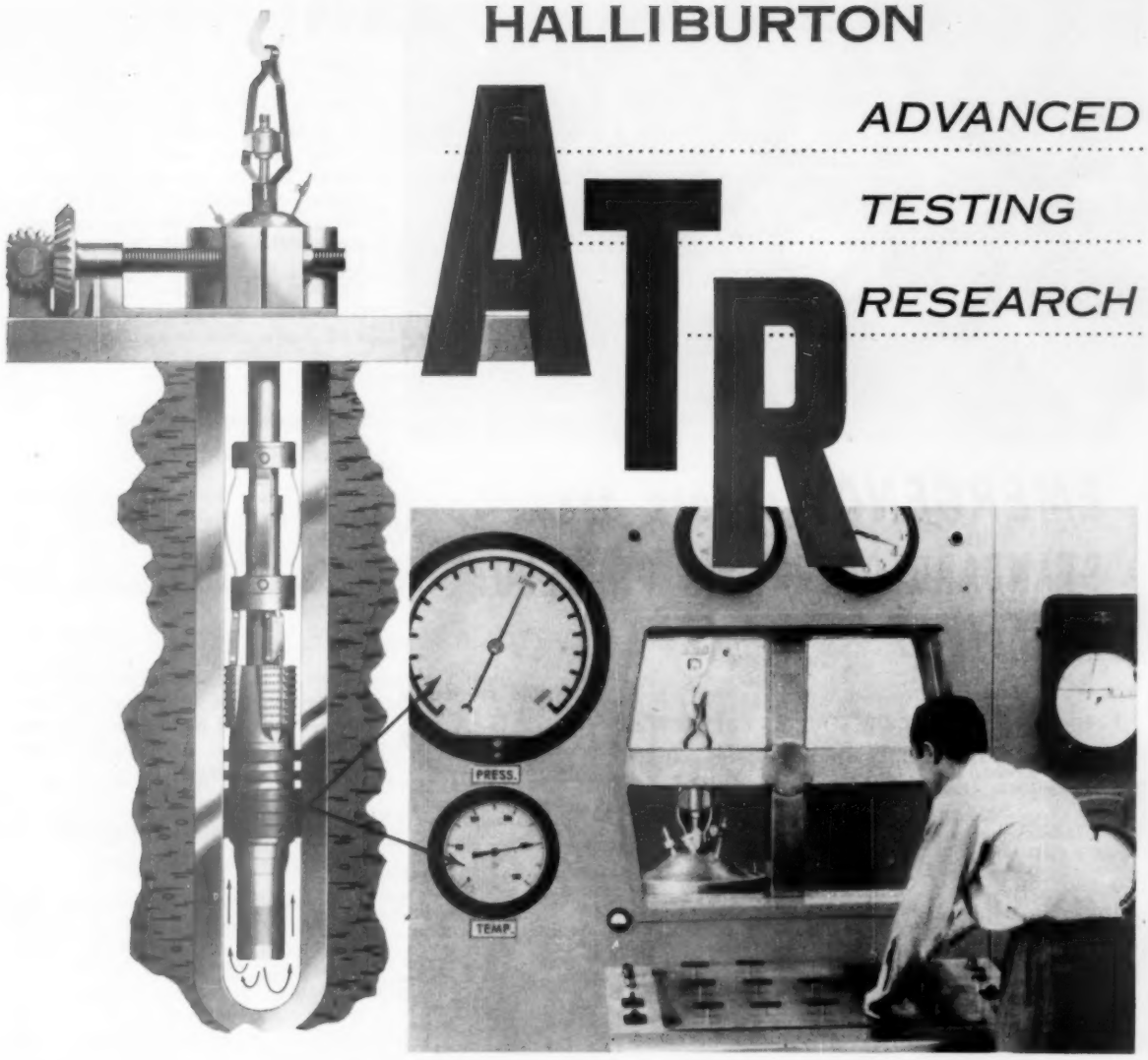

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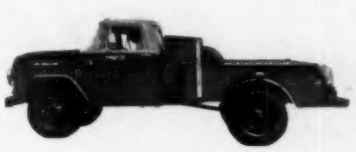

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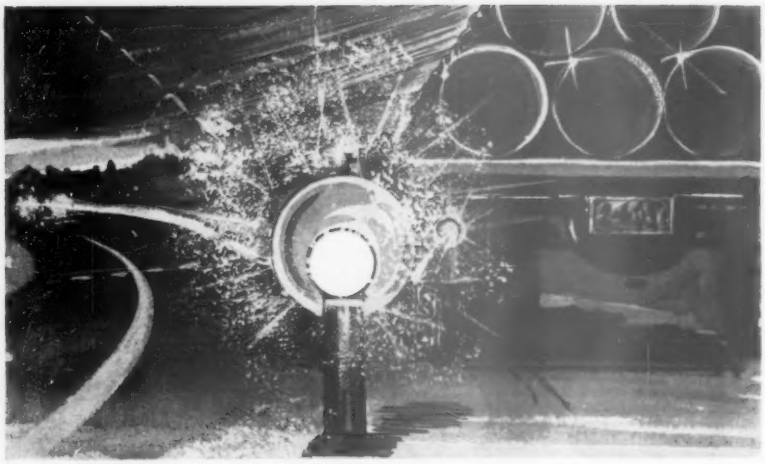

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ing well made 142 bbl. per day on 14/64-in. choke from open hole at 4,606-12 ft. This confirms the newly-opened Hayner 4,600-ft. Canyon Reef field, opened at Texam Oil Corp. 1 H. N. Smith Estate.

The discovery well of the field flowed 204 bbl. per day from perforations in Canyon at 4,596-4,606 ft. on ¼-in. choke. Other pays are indicated at this well—the Strawn reef at 4,605-23 ft., and the Flippen lime at 2,865-98 ft. Location of the confirmation well is in Section 25, Block 19, T&P Survey, 6½ miles southwest of Noodle, Texas.

New gas production opens in Panhandle

The Texas Panhandle gained another Morrow Pennsylvanian gas-producing area as a result of success at James F. Smith et al. 1-107 Dora Condon in northwestern Ochiltree County.

The big Morrow gasser is in Section 107, Block 11, W. Ahrenbeck Survey, 5 miles west of Perryton and 4 miles north of West Perryton field. Flow was 6,100 M.c.f.d. plus 13 bbl. condensate per 1 M.M.c.f. from perforations at 7,980-90 ft.

Good extension reported near San Angelo, Tex.

A well 18 miles southwest of San Angelo, ¼ mile north of 2-well Northeast Atkinson-Strawn field, flowed 525 bbl. of oil in 10 hours through various chokes on latest gage. It is Jake L. Hamon et al. 3 D. O. Atkinson in Section 1, Block 20, H&TC Survey. Perforations in Strawn are at 5,606-20 ft. at this Tom Green County, Texas extension discovery.

Wyoming's Patrick gets biggest well

WYOMING'S Patrick Draw field got its biggest oil well yet last week at El Paso Natural Gas Products Co. 5 Unit in SE SW 11-18n-99w, Sweetwater County.

This well is at the southeast corner of the field. It flowed 712 bbl. of oil daily on 24/64-in. choke from Almond Mesaverde Cretaceous perforations at 4,980-5,010 ft. This new well is 1½ miles southwest of the discovery. Two more wells were completed in section 11. The 6 Unit, ½ mile of No. 5, is waiting for completion. There are 10 active locations in the field. Five wells have been completed. One dry hole was completed.

Discovery wells

NEBRASKA

Morrill County, Dunlap:

Ohio Oil Co. et al. Dunlap, C SW NE 32-20n-51w. IPP 209 BOPD, "D" sand discovery, new field. TD 4,310 ft.

NORTH TEXAS

Archer County:

Akin & Dimock 1 R. Campbell Est., east offset to Regular field production 6 miles northeast of Olney. Sec. 1381, TE&L Sur. A-467. IPP 126 BOPD, 42°. Marble Falls 4,901-11 ft. TD 5,132 ft. New oil discovery.

Wise County:

Christie, Mitchell & Mitchell 1 Otis Meeks, 3 miles southeast of Bridgeport, A. Robinson Sur. A-706. IPAOF: 1,370 M.c.f.d., GOR 107,000:1, 58.9°, Bend 5,216 to 5,769 ft. IPF 121 BOPD, 14/64-in. choke, GOR 935:1, 42.9°, Atoka 5,099-5,109 ft. TD 6,107 ft. Dual gas and new oil.

Young County:

Bobby M. Burns 1 Weitinger, 1 mile from production, W. C. Adams Sur. A-1365. IPF 140 BOPD, 8/64-in. choke, 41°, Mississippian open hole 5,220 ft. TD 5,226 ft. New oil field.

TEXAS GULF COAST

Colorado County:

Robert Mosbacher et al. 1 Ada Pinchback et al., I&GN Sur. 12, A-317, 3½ miles west of Garwood. IP 58 BOPD, 12/64-in., 44°, TP 1,225 psi., GOR 4,010 cu. ft. per bbl., perf. 6,115-19 ft., Cockfield. TD 6,802 ft. New pay in Englehart field.

DeWitt County:

Monsanto Chemical Co. 1 Belitz, Stephen Best Sur., A-66, 3 miles south of Yorktown. IP 2,200 M.c.f.d., 60 BCPD, ¼-in., perf. 9,716-34 ft., Wilcox, and 3 M.M.c.f.d., 75 BCPD, ⅜-in., perf. 9,840-70 ft., Wilcox. TD 10,517 ft. New-field discovery.

Fort Bend County:

Goldrus Drilling Co. et al. 1 Gulf Fee, E. Kippincott Sur., A-51, 4½ miles northeast of Guy. IP 53.96 BOPD, ⅛-in., 25.8°, TP 425 psi., GOR 235 cu. ft. per bbl., perf. 5,388-93 ft., Frio. TD 6,515 ft. New-field discovery 1 mile north of Long Point field.

Goliad County:

Allen Burr 2 Elmer C. Jacob, M. de la Pena Sur., A-31, 4 miles southwest of Schroeder. AOF 17,500 M.c.f.d., dry gas, shut-in TP 1,574 psi., perf. 3,788-3,806 ft., Frio. TD 4,215 ft. New pay in North Fannin field.

Hardin County:

Scurlock Oil Co. 1 S. W. Finley, A. B. Hardin Sur., A-46, 2 miles northwest of Hardin. IP 171.25 BOPD, 8/64-in., 39.4°, TP 1,300 psi., GOR 600 cu. ft. per bbl., perf. 7,938-43 ft. TD 7,950 ft. New pay in Hardin field.

Jackson County:

La Gloria Oil & Gas Co. 1 Fehrenkamp, Section 5, C. W. Hahl Subd. of Harwood Burns Ranches, John J. Linn Sur., A-213, 5 miles south of Edna. IP 177 BOPD, 9/64-in., TP 750 psi., GOR 541 cu. ft. per bbl., perf. 5,624-30 ft., Frio. TD 6,850 ft. New pay in South El Toro field.

TEXAS PANHANDLE

Hutchinson County:

H. F. Sears 1-A Paramount, Sec. 82, Blk. 46, H&TC Sur., ½ mile west of Sanford, 30 miles southeast of Cator Tubb sand field. IPF 3 M.M.c.f.d., OH, Red Cave 1,545 ft. TD 1,612 ft. Permian Geological discovery.

Lipscomb County:

L. H. Puckett et al. Perry (OWWO), Sec. 733, Blk. 43, H&TC Sur., 2 miles northwest of Irvin 1 King Morrow discovery, 11 miles south of Booker. IPF 60 BOPD, 39.2°, Marmaton 7,624-60 ft. TD 9,985 ft. Oil discovery from old well worked over.

WEST TEXAS

Pecos County:

North Central Oil Corp. et al. 1-16 Hellon Hokit, Sec. 16, Blk. 127, T&STL Sur. IPCAOF: 6,600 M.c.f.d., Grayburg sand 2,721-52 ft. TD 2,800 ft. New gas discovery.

Upton County:

Texaco Inc. 1-DG State of Texas, 6 miles northeast of Rankin, Sec. 27, Blk. 3, Univ. Lands Sur. IPF 254 BOPD, 40/64-in. choke, 39.8°, GOR 862:1. Spraberry 7,274-80 ft. TD 11,239 ft. New oil field.

UTAH

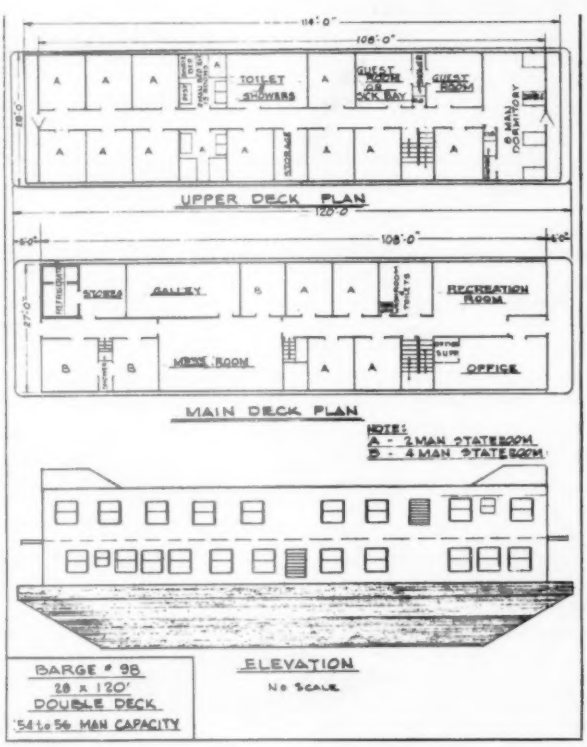
Grand County, Diamond Ridge Unit:

Sunray Mid-Continent Oil Co. 2 Unit, NE NE 23-17s-22e. IPF 1 M.M.c.f.d., ¼-in. choke, TP 1,425 psi. lower Dakota 7,254-84 ft. TD 7,660 ft. Lower Dakota Cretaceous gas condensate discovery, new field.

WYOMING

Sublette County, Hogsback area:

Mobil Oil Co. 13-31 Hogsback, SW NW 31-27n-113w. IPP BOPD, 9 BWPD, Nuggett discovery, new pay. TD 11,080 ft.



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A Texas Panhandle producer feels like he got a "new" well for the price of a frac job . . . here's how it happened:

Production had declined to 11 bopd—pumping—from an old well completed into the Cleveland sand. Completion was through perforations from 6420 to 6458 feet. Workover was considered because new offset wells tested 400 bopd on completion.

Dowell engineered a fracturing treatment with the "Frac Guide"*. Waterfrac was selected for efficiency and low cost. 40,000 gallons gelled water and 105,000 pounds sand were used. 70 gallons of Freflo* were used to prevent emulsions, and 100 ball sealers were used to divert part of the treatment into less permeable zones. Injection rate was 65 bpm at 900 to 1400 psi down seven-inch casing.

Following treatment, *production stabilized at 105 bopd flowing*. Payout time for fracture treatment was four months.

DOWELL FRACTURING AND ABRASIJET HELP GET GOOD PRODUCTION FROM "PROBLEM" FIELD

Wells in the Langlie Mattix field of Lea County, New Mexico, are hard to produce. The oil pay of the Seven Rivers formation is tightly sandwiched between water below and gas above. It will not produce satisfactorily without stimulation—yet fracturing usually results in water or gas rather than oil.

Dowell engineers suggested a two-stage treatment that is working extremely well. First, Abrasijet* is used. The jetting tool is set in the middle of the oil zone at about 3585 feet, and the walls of the open hole are jetted with oil and sand. This produces considerable enlargement of the well bore.

Then wells are fractured, using 10,000 gallons lease crude and 10,000 pounds sand. This relatively small treatment is designed to provide the needed stimulation without breaking through to either gas or water.

Success has been outstanding. *The first fifteen wells treated are all producing their allowables; only two are producing appreciable water and none have broken through to gas.*

OPERATOR USES DOWELL FRACTURING TO STRETCH OUT DECLINE CURVE

Wells completed in the 'D' sand of the Southwestern Wayne pool in McClain County, Oklahoma, had not responded well to fracturing. Usual treatments had been 10,000 to 20,000 gallons of refined oil carrying one pound of sand per gallon. Initial production would be satisfactory but production would decline rapidly—frequently approaching pre-treatment levels in less than a month.

Dowell engineered a treatment with the "Frac Guide". Petrojel* was recommended for a well completed through perforations from 6977 to 6994 and from 7062 to 7076 feet. 20,000 gallons gelled crude with F.L.A.* (Fluid Loss Additive) and 46,000 pounds sand were used. 25 ball sealers were injected at mid-treatment. Injection rate was 21 bpm. *Before treatment, production was 10 bopd. Three months later, production had STABILIZED at 30 bopd.*

GOOD GAS/OIL RATIO RESULTS WHEN KANSAS OPERATOR USES DOWELL FRACTURING AND ABRASIJET

Wells completed into the Mississippi Chat of the Spivey-Grabs pool in Harper County, Kansas, have a GOR limit of 3000/1. An operator wanted to fracture to improve production—yet not break through to gas. Abrasijet was used to perforate casing at 4464 feet. Then, following treatment with 500 gallons Mud Acid, well swabbed 12 barrels of oil in seven hours.

After fracturing with water and 3500 pounds sand the well *flowed* 10 boph on a ¼"-choke. *Gas/oil ratio was only 1323/1—exceptionally good for the field.*

Your Dowell engineer can help you select a treatment to solve your well problem. Call him for further information or service. Dowell services and products are offered from more than 150 offices and stations in the United States, Canada, Argentina, and Venezuela. Dowell, Tulsa 1, Oklahoma.

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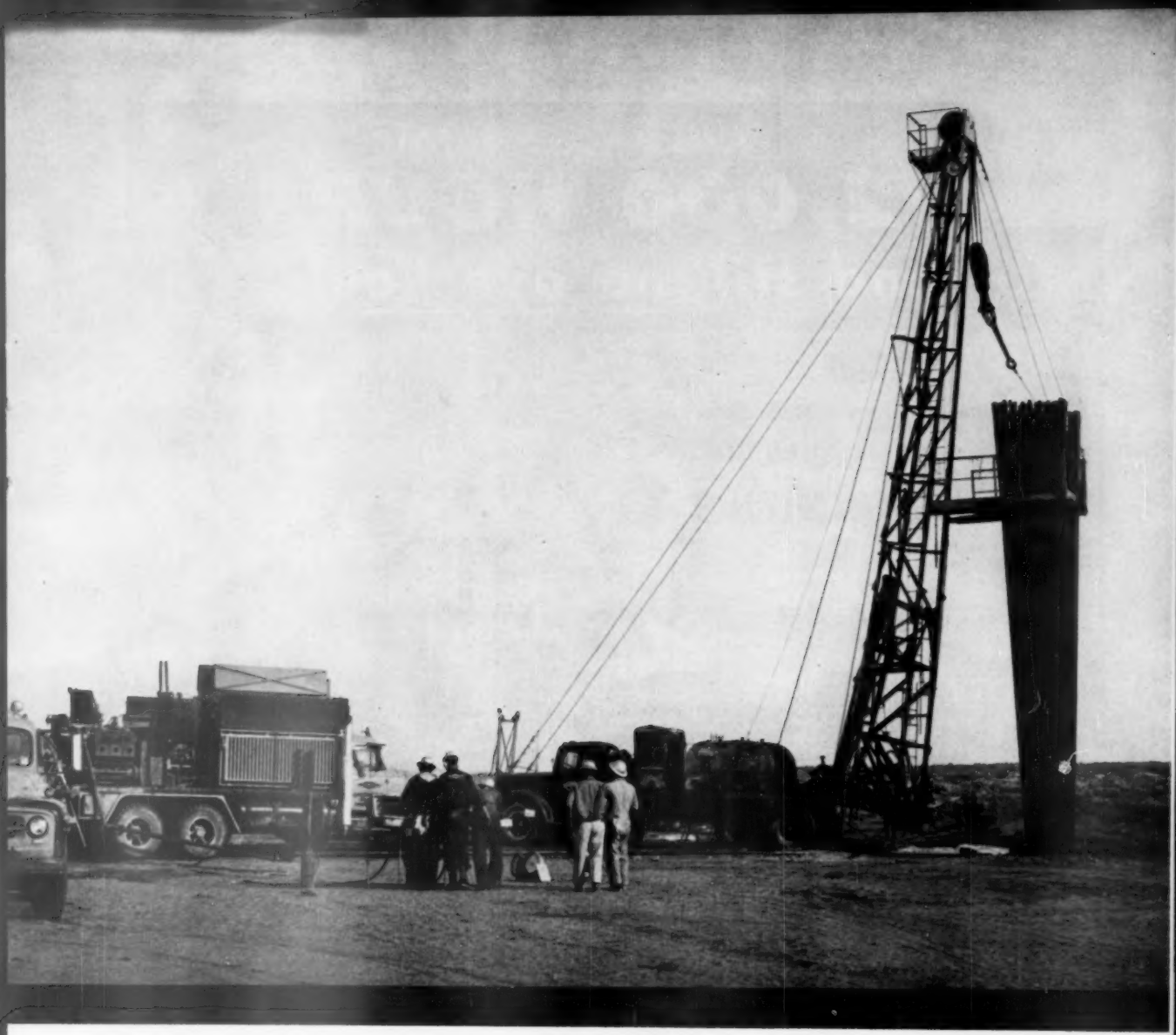

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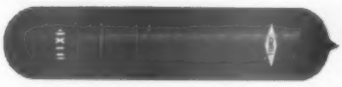

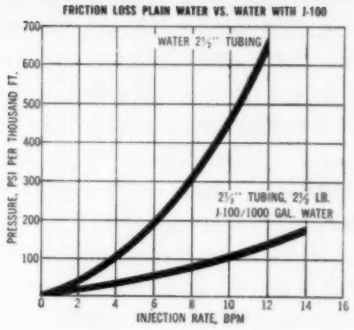

ROCKSHOCK*

This new Dowell service employs glass *implosion* capsules to clean formations or reduce breakdown pressures ahead of fracturing or acidizing treatments. Hydrostatic pressure is used to break the capsules. This action releases powerful pressure waves — to remove scale and other deposits, break emulsion blocks, and to initiate fractures.

ABRASIJET

This Dowell-developed service employs a special new tool to direct high velocity streams of abrasive-laden fluid against pipe or formation. The service is used to perforate pipe and penetrate through the damaged area near the well bore. Operators have also used it to clean and enlarge open holes. Results have been consistently **excellent.**

J-100

J-100 is Dowell's new, improved thickening and friction reducing agent for fresh water. It effectively improves the sand-suspending qualities of water. More important, however, is its ability to reduce friction losses and pump requirements by more than one-half as shown on the graph. The result can be better fracturing at lower cost.

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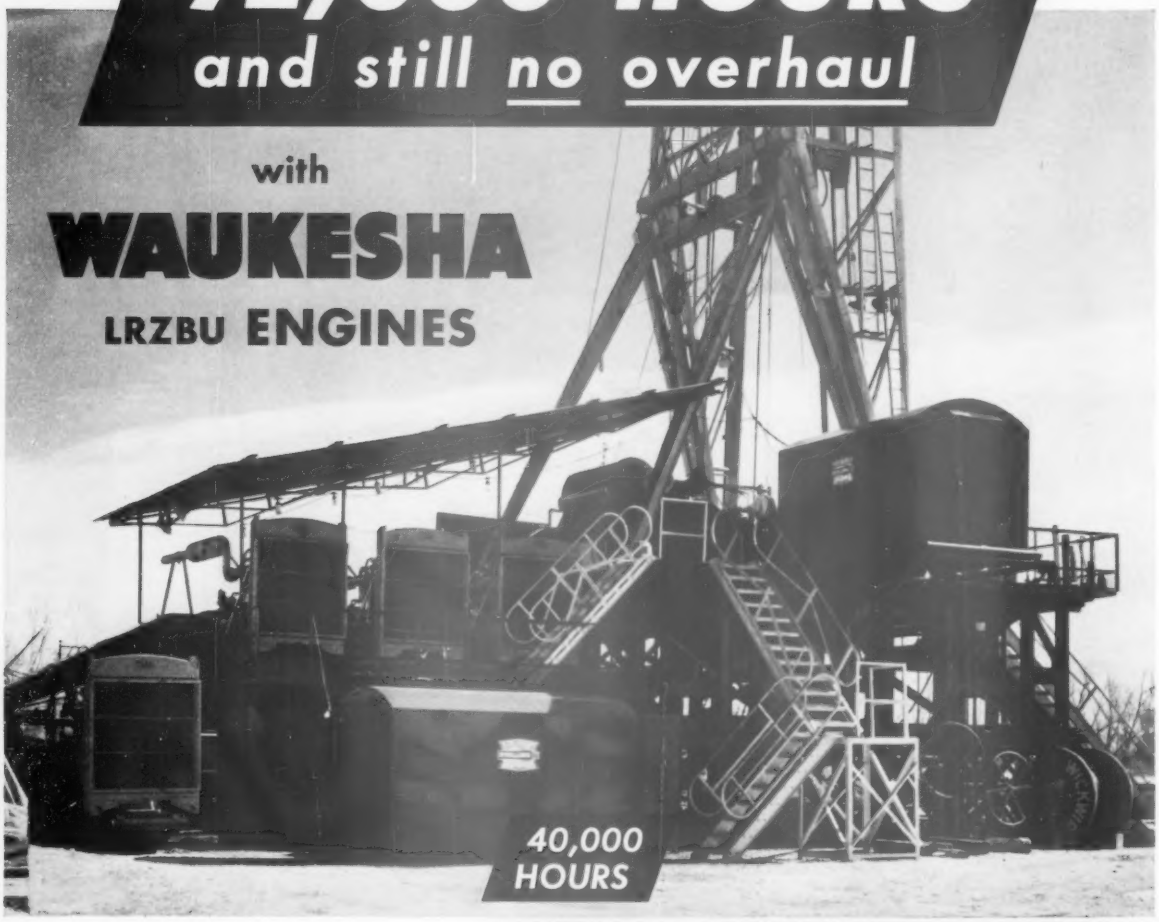
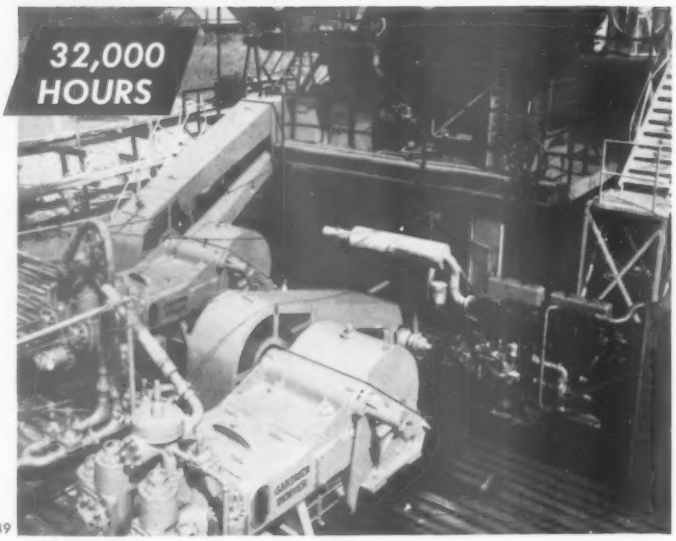
with

WAUKESHA LRZBU ENGINES



Two FRED WILSON DRILLING CO. rigs shown operate in southern Louisiana. Rig 12 has four and Rig 9 has three Waukesha gas power units, Model LRZBU, six cyl., 9⅜-in. bore x 8½-in. stroke, 3520 cu. in. displ. Rig 12 (above) has 40,000 hours service; Rig 9 (right) 32,000 hours. No engine has had any overhaul, and practically no repairs, reports Mr. Fred Wilson . . . these are just some reasons why his equipment is 100% Waukesha powered. He operates six rigs (two each of National 110, 80B and 55 sizes) and sixteen Waukesha LRZBU; three LRO; one each NKU, WAKU, 145-GKU; and several XAHU power units. Send for Bulletins.



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WAUKESHA MOTOR COMPANY, WAUKESHA, WISCONSIN / New York • Tulsa • Los Angeles
Factories at Waukesha, Wisconsin and Clinton, Iowa

Dan W. Cameron . . . heads up two companies.

There's Plenty of Opportunity

. . . for anyone in the oil business, says Dan Cameron, who has proved you can chuck a good job and be independent.

THE BEST TIME to enter the oil business is anytime—for anyone ready to give it the old college try.

Dan W. Cameron has earned the right to mount a podium and preach this philosophy.

"I would never, never discourage a young person from beginning a career in the oil industry," he says. "And that goes for any phase of the industry. It's all loaded and waiting for the right touch, and it'll respond to initiative and enterprise in rewarding fashion.

"There is a lot of opportunity now—a lot of opportunity—in spite of current depressed situations which we hear about. Jobs aren't as easy to get as they have been, but we need competition to give us a greater appreciation of the chances for individual progress in oil."

Speaking is the president of two companies. One company is 5 years old, the other in its first year of operation. Cameron has cut quite a swath in 5 years, and his feeling and that of his business associates is they have only scratched the surface. Around the corner are even greater advances.

Cameron walked away from 20 years' seniority with Carter Oil Co. to begin on his own. That was New Year's Day, 1955.

In February, Kenland Oil Co. began operation, handling 350 bbl. daily of crude in Illinois. There were two company employes—Cameron and a secretary.

Now, Cameron Crude Oil Corp. of Tulsa, Kenland's successor, is handling 15,000 bbl. of crude daily in Kansas, Oklahoma, Texas, Arkansas, Illinois, and Nebraska. There are 30 employes, fleets of rented tank trucks, and miles of pipelines and gathering systems.

Last year Wheat Belt Pipe Line Co., with Cameron as president, completed a 44-mile 6 and 8 in. line. It extends from Sun's gasoline plant at Laverne, Okla., through Southeast Stockholm and Buffalo fields of Oklahoma to connect with the Jayhawk Pipe Line Corp. lines in Clark County, Kansas.

How he operates . . . Cameron's operations system is simple. His associates spot critical points where crude supplies are not served by pipelines. They weigh the economics of overland motor transport, contact producer and consumer, and Cameron trucks go to work.

He's flown and driven tens of thousands of miles in the 5 years, personally screening projects which might come to life with the Cameron touch. He's never found a "sure thing" yet. He feels a "pinch of risk" is a stimulating thing.

"There is a tendency, in business and in individual considerations, to think in terms of a welfare state," he says.

"There are some who look for security more than for opportunity.

"I'm much more interested in a young person who wants to know what the opportunities are—in a deal or in a job—than in one who wants to know first what will it pay, how sure-fire it is, and what the guaranteed benefits are."

Cameron was born to oil, in Joplin, Mo., but shunned it in early years.

His father and grandfather were oil producers. The family moved to Pittsburgh, then to Portland, Ore. and on to Muskogee, Okla. when young Cameron was 5 years old. His grandfather brought in Boynton field, near Muskogee.

After finishing high school in Tulsa, he attended Butler university, Indiana, and was graduated with an English journalism major at UCLA, Los Angeles, in 1933. While in school, he earned his way washing dishes in a sorority house and selling subscriptions to The Oil and Gas Journal in spare daylight hours.

After graduation, he sold magazine subscriptions on a commission basis for 2 years in the gulf coast area, then began work as a hall boy-receptionist at Carter Oil Co., Tulsa. He became division scout, chief scout, assistant to the president, and finally manager of the crude oil purchasing department in his 20 years there. He spent 26 months with the Seabees.

Cameron took a wide acquaintance with crude oil buyers, scouts, and landmen with him when he began business for himself. It was tough to leave company security and status as a department head to go it alone. But he's never looked back.

New deals are in the mill, new horizons are beckoning right now for the Cameron group. The next 5 years might just put the last five in the shade.

●

Alex T. Sturrock, formerly with Moreland Corp., has joined Goodrich-Gulf Chemicals, Inc., as senior development engineer, new products development, in the company's Institute, W. Va., laboratories. He will work with new applications for synthetic rubber.

Bill Osborn will head Continental Oil Co.'s Anchorage, Alaska, office, succeeding **Roger Dungan,** senior geologist. Dugan has been transferred to Houston for reassignment.

▶▶▶ Personals

J. W. (Joe) Meehan, former president of Colorado Oil & Gas Corp.'s Derby Refining Co. division, has joined Vickers Refining Co. as president. Vickers Refining, new division of Vickers Petroleum Co., includes the manufacturing, transportation, and marketing departments of the parent company. Meehan also has been elected a director and vice president of Vickers Petroleum. **James W. Vickers,** executive vice president, continues in charge of marketing, and **P. A. Blasco** continues as vice president in charge of manufacturing. Meehan had been with Derby since 1957 and was named president last year. He was also president of Jayhawk Pipeline Co., which is jointly owned by Colorado Oil & Gas and National Cooperative Refinery Association. **W. G. Tierney,** former Derby president, now vice president and a director of Colorado Oil & Gas, will take over management of Derby until a permanent successor for Meehan is chosen.

MEEHAN

E. E. Runyan, assistant foreman in Russell, Kans., for Sohio Petroleum Co., has been promoted to district engineer in Midland, Tex.

George S. Wilson, formerly engineer with Magnolia Petroleum Co. in Houston, has been transferred to Corpus Christi, Tex., as process engineer with Mobil Oil Co.

Edwin J. Egan, formerly assistant to the manager of Mobil Oil Sudan, Ltd., has been named assistant to the general manager of Mobil Oil do Brasil. He will headquarter in Sao Paulo.

N. J. Matthews, Shell Oil Co., has been elected 1960 chairman of the Billings, Mont., petroleum section of AIME's Society of Petroleum Engineers. Other officers are **George Ellis,** Schlumberger Well Surveying Corp., vice chairman-membership; **Guy J. Lookabaugh,** Humble Oil & Refining Co., vice chairman-programs; and **R. L. Spottswood,** Shell Oil Co., secretary-treasurer. Directors include **Earl Whitaker,** Northern Pacific Railway, oil development division, student counselor and director; **J. T. Thorton,** Texaco Inc.; and **Ray Miller,** Northern Natural Gas Co.

W. H. Peterson, assistant division sales manager in charge of industrial sales for Texaco Inc. in Seattle, has been named special representative in charge of industrial sales, Pacific Coast region. He will headquarter in Los Angeles.

A. R. Rehrig, assistant to the manager of manufacturing in Phillips Petroleum Co.'s refining department, has been promoted to manager, market development, in the sales and development division of the international department. He will headquarter in New York.

Oscar L. Keesee, H. Norman Winkle, and **David W. Kirtley** have formed KWIK Oil Co., Oklahoma City independent company. Keesee formerly was general manager and partner for Jocelyn-Varn Oil Co., Wichita. Winkle was Oklahoma district manager for Jocelyn-Varn. Kirtley has been an independent operator since 1954.

W. Lewis Perryman, Jr., executive vice president and general counsel of General American Oil Co. of Texas, has been elected a director and member of the executive committee. **Frederick H. Connally,** vice president and treasurer, also becomes a director and executive committee member. **James S. Cleaver,** formerly assistant to the president, and **Fred C. Higginbotham, Jr.,** controller and assistant secretary-treasurer, have been elected vice presidents. **Martin Vernon,** staff geologist, has been elected assistant vice president.

J. W. Simmons, general sales manager for Atlantic Refining Co. of Brazil, has been appointed vice president and general manager of the company. He succeeds **R. M. Sebastian,** who has resigned. Simmons joined Atlantic Refining Co. in 1949 and was transferred to the Brazilian company in 1952. He will continue to headquarter in Rio de Janeiro.

David K. Taylor, manager of Mobil Exploration Portugal, has been named manager of Mobil Producing Tunisia, Inc. Mobil recently entered a joint exploration agreement with SEREPT, Tunisian company owned by French and Tunisian private and government capital. Mobil men assigned to Mobil-SEREPT exploration include **Edwin F. Helser,** formerly in Turkey, who will be exploration manager; **Donald W. MacLean,** formerly in West Africa, senior geologist; **James R. Fasbender,** formerly in West Africa, assistant chief geophysicist; and **John F. Schleinich,** chief seismic interpreter. Schleinich was with Mobil Oil Francaise in Paris.

Gerald F. Slattery, geophysicist with Shell Oil Co., has been transferred to Durango, Colo., from Salt Lake City. **Ronald H. Kadwell,** junior geologist in Farmington, N. M., has been promoted to geologist there. **Peter J. Fischer,** junior paleontologist, has been promoted to paleontologist in Salt Lake City.

Lawrence E. Brock, formerly assistant to the division production superintendent in Pan American Petroleum Corp.'s North Texas-New Mexico division, Fort Worth, has opened consulting offices in Farmington, N. M.

W. L. Crawford, president of Motex Oil Co., San Antonio, Tex., and **H. Malcolm Lovett,** Houston attorney, have been elected directors of Commonwealth Oil Co., Houston. Crawford is a former president of Petty Geophysical Engineering Co. Lovett is a director of Tennessee Gas Transmission Co.

Byron E. Milner, general superintendent of Atlantic Refining Co.'s Atreco refinery, Port Arthur, Tex., has been named manager of the refinery. He succeeds **Paul L. Robison,** who has retired after 34 years with Atlantic. **Albert W. Kusch,** technical assistant to the manager at Port Arthur, will succeed Milner as general superintendent. Milner joined Atlantic in 1939 at the Philadelphia refinery. He moved to Port Arthur in 1956 and was appointed general superintendent there in 1957. Kusch has been with the company since 1941.

MILNER

KUSCH

A. I. Levorsen, Tulsa consulting geologist, has been elected to honorary membership in the Society of Economic Paleontologists and Mineralogists. He will be recognized during the society's annual meeting April 26. Levorsen is a past president of American Association of Petroleum Geologists, Geological Society of America, and the American Geological Institute. **John A. Wilson,** professor of geology at the University of Texas, also will be honored by SEPM as author of the best paper presented at last year's Dallas convention.

▶▶▶ Personals

William G. Copeland, general manager of the domestic refining department of Texaco Inc., has been elected vice president, domestic refining. Copeland succeeds **Frederic H. Holmes,** who has retired after 32 years with Texaco. **Henry Flynn,** manager of Texaco's Port Arthur, Tex., refinery will succeed Copeland as general manager, domestic refining department. Copeland joined Texaco as a chemist in Port Arthur. He has been superintendent of the Sunburst, Mont., and Westville, N. J., refineries, and general superintendent of the Port Arthur works. He was named refining operations manager in New York in 1956 and general manager in 1957. Flynn joined the company in 1927. He had held the Port Arthur post since 1958.

COPELAND

FLYNN

Bert W. Huls has been named district sales manager in Denver for Humble Oil & Refining Co.'s Carter Division. **H. B. Egger** has been named Carter district sales supervisor in Seattle. **J. B. Wadell** has been named Colorado Springs, Colo., district sales manager.

C. L. Bushager has been appointed drilling superintendent for Delhi Australian Petroleum, Ltd., in the Great Artesian basin. Bushager was with International Drilling Co. before joining Delhi Australian earlier this year. **John Harrison,** formerly with Mobil Oil of Canada, has joined Delhi Australian as geologist.

A. O. Detmar, president of Mobil Oil of Canada, has been elected chairman of the Canadian Petroleum Association's board of governors. He succeeds **E. C. Babson,** Union Oil Co. Babson, now manager of Union's foreign operations division in Los Angeles, and **R. C. Brown,** now managing director of Continental Oil, Ltd., in London, were presented honorary life memberships in CPA at the association's annual meeting last week. Both are former chairmen of the CPA board of governors. Babson was formerly manager of Union's Canadian division in Calgary. Brown is a former president and general manager of Hudson's Bay Oil & Gas Co., Ltd.

William H. Thorbecke, formerly manager of Continental Carbon Co.'s international division and managing director of its overseas subsidiary, has been named assistant manager of Mobil International Oil Co.'s petroleum chemicals division.

Clifford E. Oman, general manager of U. S. Industrial Chemicals Co.'s Tuscola, Ill., petrochemical plant, has been named assistant to the director of production for the company. **James R. Smith,** plant manager in Tuscola, will take over full responsibility for operations there.

Harold L. Hensley, superintendent of Humble Oil & Refining Co.'s western operations in Midland, Tex., and **Errol R. Wagner,** superintendent of Pan American Petroleum Corp.'s North Cowden, Tex., gasoline plant, received recognition awards at the recent Permian Basin regional meeting of Natural Gasoline Association of America. The awards are made for individual service to the natural-gasoline industry.

Virgil J. Berry, Sinclair Research Laboratories, Inc., has been elected chairman of the Mid-Continent section of AIME's Society of Petroleum Engineers. Other new officers include **H. A. Nedom,** Amerada Petroleum Corp., first vice chairman; **Wayne Swearingen,** consultant; second vice chairman; **J. W. W. Whitney,** Helmerich & Payne, Inc., secretary; and **Philip L. Essley, Jr.,** Skelly Oil Co., treasurer. Members of the executive committee are **Rex Benway,** Schlumberger Well Surveying Corp.; **Ted M. Geffen,** Pan American Petroleum Corp.; **E. T. Guerrero,** University of Tulsa; **Sam Mabry,** Cities Service Oil Co.; and **Walter R. Evans,** Phillips Petroleum Co.

Thomas C. Lockhart, formerly manager of Mobil Oil Co.'s Buffalo, N. Y., refinery, has been named manager of crude programs in Mobil's supply and distribution department. **David Christison,** manager of the East Providence, R. I., refinery, will succeed Lockhart in Buffalo. **Boris L. Rodzianko,** assistant manager of the Ferndale, Wash., refinery, has been named East Providence manager, succeeding Christison. **Wayne H. Howard,** manager of manufacturing coordination and control, has been named manager of engineering and technical coordination in the manufacturing department. **Paul A. Rene,** formerly with Mobil International Oil Co.'s supply and distribution department, has been named manager of analysis and control in Mobil Oil's manufacturing department.

Henry S. McQueen, executive vice president, chief geologist, and a director of Salt Dome Production Co., has resigned to open consulting offices in Houston. McQueen will continue as a consultant to Salt Dome.

M. C. Alcorn, manager of Shell Oil Co.'s West Coast pipeline department, has retired after 33 years with the company. He had been West Coast pipeline manager since 1946.

Gordon W. Walker, manager of the pipeline division of Mannix Co., Ltd., has been elected president of the Pipe Line Contractors Association of Canada. He succeeds **D'Arcy J. Baldwin,** Marine Pipeline & Dredging, Ltd. Other new officers include **W. Douglas Porter,** Mid-Canada Contractors, Ltd., first vice president; **W. A. (Bill) Rose,** Majestic Contractors, Ltd., second vice president; and **George A. Wilkinson,** Maxwell Construction, Ltd., treasurer. Directors are Baldwin; **W. I. (Bill) Daniels,** Dutton-Williams Brothers, Ltd.; **Ron K. Banister,** Fulton Banister, Ltd.; and **R. B. Somerville,** Robert B. Somerville Co., Ltd.

WALKER

Francis L. Cohagan, senior assistant engineer in Texas Eastern Transmission Corp.'s Division 3, West Chester, Pa., has been promoted to Division 4 engineer, Baytown, Tex. Cohagan joined Texas Eastern in 1953 as a junior engineer.

James A. Davis, vice president in charge of gas supply operations for Pioneer Natural Gas Co., has been elected president, general manager, and a director of Pioneer Gathering System, Inc., a subsidiary. **B. P. Smith,** former president of the subsidiary, has been named a Pioneer Gathering vice president. Smith is vice president and treasurer of Pioneer Natural Gas and a director of Pioneer Natural and Pioneer Gathering. On the Pioneer Gathering board, Davis succeeds **A. F. Cox,** president of Amarillo Oil Co., also a Pioneer Natural subsidiary, and a director of the parent company. **W. A. (Bill) Paxton,** manager of corporate taxes for Pioneer Natural, has been named treasurer of Pioneer Gathering. He succeeds **Vernon D. Rigdon,** who has resigned. **Jack Gholson** has been named assistant treasurer.

Personals

William S. Webb, advanced process engineer with Socony Mobil Oil Co., Inc., in Paulsboro, N. J., has been transferred to New York and promoted to lube-oil supply program coordinator.

Henry Kerr, general superintendent of operations for Delhi-Taylor Oil Corp., Dallas, has been elected chairman of American Petroleum Institute's southwestern district, division of production. He succeeds **L. L. McDonald,** Pure Oil Co., Fort Worth. McDonald has been named chairman of the district advisory committee. **Henry P. Shackleford,** Tidewater Oil Co., Hobbs, N. M., has been named district secretary-treasurer. New vice chairmen include **J. W. Sallee,** Cardinal Chemical Co., Midland, West Texas area; **Charles Foster,** Gulf Oil Corp., Wichita Falls, North Central Texas; **George Geyer,** Cities Service Oil Co., Hobbs, southeastern New Mexico; **Al Greer,** Benson-Montin-Greer Drilling Corp., Farmington, northwestern New Mexico; **E. C. Mlcak,** Standard Oil Co. of Texas, Gainesville, northeast Texas; and **C. E. Smith,** Western Co., Lubbock, Tex., south plains. Officers were named at the district's recent meeting in Dallas. Four oil men were honored with API citations for service during the meeting. They were **Harry N. Stansbury,** Atlantic Refining Co., Dallas; **Wayne C. Moody,** Sunray Mid-Continent Oil Co., Midland; **Tom B. Campbell,** J. P. Gibbins, Inc., Midland; and **W. R. Johnston,** Aspen Drilling Co., Albuquerque.

Francis Barker, formerly superintendent in Coalinga, Calif., for Union Oil Co., has been named resident manager in Las Palmas, Canary Islands. **Harold Billman,** division geologist for Union, also has been transferred to Las Palmas for work in the Spanish Sahara.

Jay K. Beard, Shell Oil Co. mechanical engineer in Ventura, Calif., has been transferred to Farmington, N. M., as production foreman. **Thomas D. Roberson,** formerly production foreman in Farmington, has been transferred to Saticoy, Calif., in the same capacity. **Karl W. Bruckner,** junior mechanical engineer in the Los Angeles area, has been named exploitation engineer in Ventura.

G. A. Lorenz, manager of Shell Oil Co. of Canada's Shellburn refinery, Vancouver, will become manager of the Montreal refinery June 1. He will succeed **L. T. Wilson,** who recently was appointed manager of Shell Oil Co.'s Norco, La., refinery. **A. C. Hogge,** assistant manager of the Montreal refinery, has been named assistant manager at Shellburn and will succeed Lorenz as manager there in June. Lorenz has been with Shell for 24 years and with Shell of Canada since 1955. Hogge joined Shell Oil in 1937.

Henry H. Beeson, natural gas manager for Mobil Oil Co.'s Houston division, has been named Mobil natural gas coordinator, a new position. He will headquarter in Dallas. Beeson will coordinate gas contracts and policy matters among company divisions, handle FPC relations, and be in charge of all gas sales and gas purchase contracts.

Gerald Rickles, formerly with Union Oil Co. in Santa Fe Springs, Calif., has been transferred to Bakersfield, Calif., as division geologist.

W. S. Frisbie, special representative for Falcon Seaboard Drilling Co., has been transferred from Tulsa to the company's new regional office in Dallas.

Earl H. Johnson, executive vice president of Mohawk Petroleum Co., and **Lloyd Kirk,** vice president, have been elected directors of the company. **Leon C. Gavras** has been elected secretary.

Dr. Melvin DeGroote, vice president in charge of research, development, and patents for Tretolite division of Petrolite Corp., has retired. He will continue as a consultant for Petrolite.

Deaths

Richard Edward Wright, manager of Venezuelan operations of Texaco Inc., died February 29 in a New Orleans hospital after a brief illness. Wright had been with Texaco since 1946.

Emmett M. (Mutt) Donovan, 58, mid-continent division manager for Martin-Decker Corp. died February 19 at his home in Oklahoma City after a heart attack. He had been with Martin-Decker since 1946.

Col. Thomas K. McElroy, 54, Ohio Oil Co. attorney in Houston, died March 2 in his home after a heart attack. He had been with Ohio since 1950.

George Armistead, Jr., founder of George Armistead & Co., St. Michaels, Md., consulting engineering firm, died February 27 after a heart attack. Armistead was with the Petroleum Administration for War as chief, technological section, during World War II. He had been with Texaco Inc., Republic Oil Refining Co., and Foster Wheeler Corp. before setting up his own company.

Marshall Haddock, Jr., 61, Tulsa independent operator, died March 3 in a Tulsa hospital.

Harry R. Paramore, 78, independent operator in the Spindletop area prior to 1940, died March 3 in a Beaumont, Tex., home for the aged. Paramore was a pioneer union organizer in Spindletop field and was a delegate to the El Paso, Tex., meeting which organized the International Association of Oil Field, Gas Well, and Refinery Workers in 1919. He sold his oil holdings before World War II.

Emmett P. Tatum, 55, chief divisional paleontologist for Humble Oil & Refining Co., died March 5 in Houston after a heart attack.

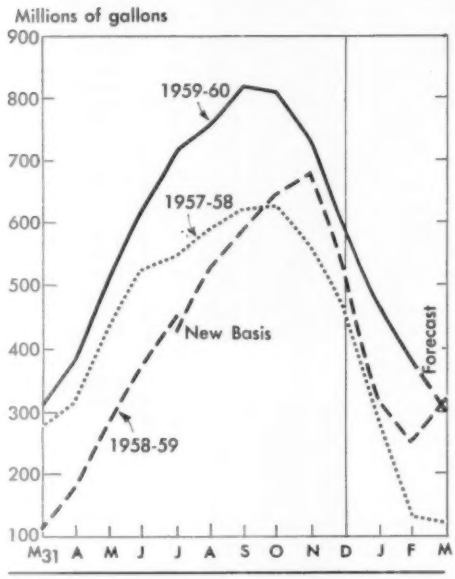
Forrest Lee Philpott, 61, an operating foreman at the West Tulsa refinery of Texaco Inc., died March 7 in Tulsa after a heart attack. Philpott had been with Texaco 38 years.

Rufus J. Lackland, 63, attorney with Gulf Oil Corp. in Houston, died March 5 in a Houston hospital after an illness of several years.

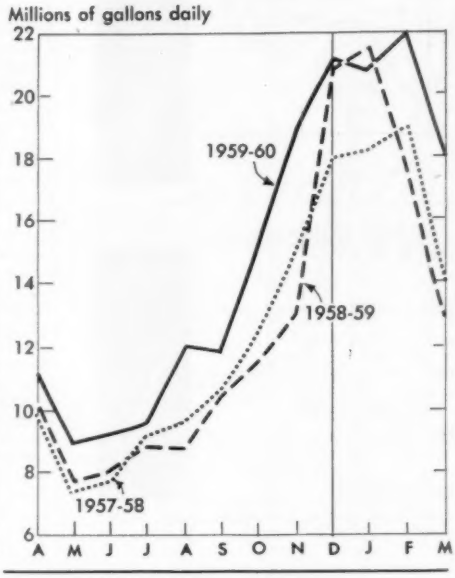
Donald Haight, drilling foreman for Belco Petroleum Corp., was killed recently during a blowout and fire at a wildcat in Sublette County, Wyoming.

Robert L. Mockbee, 41, Indianapolis district marketing sales specialist for Ohio Oil Co., died March 6 while en route to Brownsburg, Ind., by car. Mockbee had been with Ohio since 1938.

Propane Stocks



Demand for Propane



STOCKS of LP-gas have been climbing rapidly in recent years. Propane stocks increased 123 million gallons in a single month last year. This gain was more than the total of all LP-gas in storage at any time in 1951.

Propane demand for February is estimated at 22 million gallons daily, an all-time high for any month. March demand is expected to be about 4 million gallons daily higher than the previous March record.

Severe weather helps LP-gas operators

BY JOHN C. CASPER

COLD WEATHER in late February and early March, particularly in the Southeastern States, has been a major factor in getting LP-gas producers off the hook for the coming summer season.

Propane has been selected to show trends in LP-gas demand and stocks because its prime use is for heating and cooking. Aboveground storage for LP-gas is so expensive that the high cost of adding to inventories during the summer months was a limiting factor in the growth of LP-gas demand until after World War II. Even as late as 1950, total LP-gas stocks didn't go above 65 million gallons during the summer buildup season and were down to 39 million gallons at the end of January. But the situation has changed.

Stocks of propane alone reached an all-time high of 822 million gallons at the end of September last year. And on that date, total stocks of LP-gas and LR-gas reached the all-time peak of 1.22 billion gallons, including 1.06 billion gallons in underground storage.

At the end of September 1959, propane inventories showed a gain of 238 million gallons over the year before. Total LP-gas stocks represented an increase of 300 million gallons. Underground storage of these products showed a gain of 334 million gallons.

Note that there was very little reduction in propane stocks last October. Some operators were wondering what they would do with surplus propane if stocks followed the 1958 pattern and continued to show gains until the end of November.

Cold weather in November provided the answer with a good stock decrease for the month. Also, inventories declined seasonally during December and January.

But at the end of January, propane stocks still were 154 million gallons higher than the year before and total LP-gas was showing a gain of 231 million gallons.

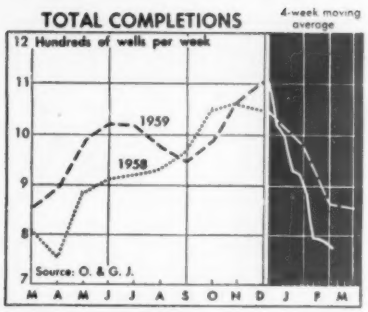
Cold weather again saved the day in late February and early March. It is estimated that propane stocks dropped at least 120 million gallons in February and will decrease 50 million in March. By the end of the month, stocks will be lower than last year.

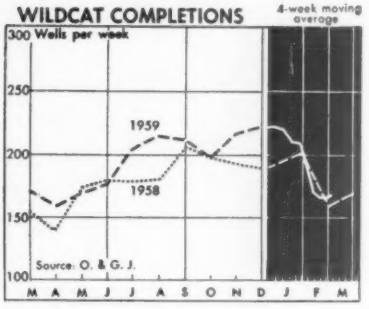
These late-season reductions will provide some much-needed space to store products from the expected increase in plant operations this summer.

A quick look at the highlights . . .

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,194,640	DOWN	137,900	DOWN	12,360
Crude stocks	253,149,000	UP	1,533,000	DOWN	5,971,000
Completions	739	DOWN	56	DOWN	121
Refinery runs	7,922,000	DOWN	186,000	DOWN	285,000
Gasoline stocks	218,938,000	UP	3,315,000	UP	11,923,000
Kerosine stocks	20,590,000	DOWN	1,288,000	UP	1,605,000
Distillate stocks	101,554,000	DOWN	7,261,000	UP	20,938,000
Residual stocks	44,084,000	DOWN	1,215,000	DOWN	10,751,000
Four-product stocks	385,166,000	DOWN	6,449,000	UP	23,715,000
Total imports	1,893,200	DOWN	3,600	DOWN	736,700

DRILLING





Active Rotary Rigs

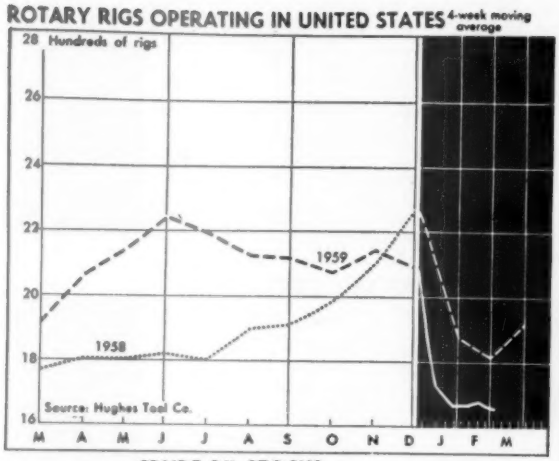
	3-7-60	2-29-60	3-9-59
Alabama	4	4	8
Arkansas	15	17	13
Arizona	1	1	0
California	84	80	87
Land	79	75	85
Offshore	5	5	2
Colorado	18	22	29
Florida	1	1	2
Land	0	0	2
Offshore	1	1	0
Illinois	15	21	12
Indiana	4	4	4
Iowa	0	0	3
Kansas	99	91	126
Kentucky	5	5	3
Louisiana	294	282	296
North	22	25	21
S. Inland waters	138	125	142
S. Land	87	85	98
Offshore	47	47	35
Maryland	0	0	1
Michigan	39	37	20
Mississippi	63	69	61
Missouri	0	1	0
Montana	12	12	18
Nebraska	22	23	22
Nevada	0	0	0
New Mexico	98	94	95
New York	0	0	0
North Dakota	11	8	37
Ohio	3	3	3
Oklahoma	180	196	199
Oregon	0	0	0
Pennsylvania	6	8	13
South Dakota	0	0	1
Texas	598	595	698
S. Inland waters	8	8	8
S. Land	164	167	124
Offshore	0	0	1
North	40	38	147
Panhandle	50	45	(*)
East	41	48	(*)
West Central	198	194	252
West	97	95	166
Utah	25	28	40
Washington	0	0	0
West Virginia	4	4	4
Wyoming	55	54	52
Total U. S.	1,656	1,660	1,847
Western Canada	241	248	226
Easteren Canada	3	4	0
Grand total	1,900	1,912	2,073

Hughes Tool Co. report. *Included in North. Comparisons not available due to change in method of reporting.

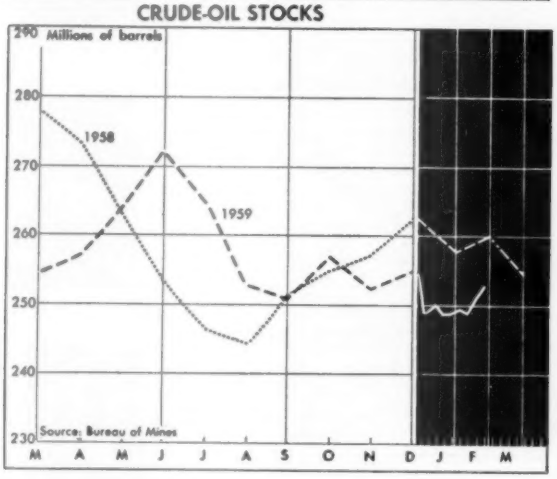
WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 5, 1960

	Total wells							Cum.		Total wildcats					Cum.	
	Total	Crude	Cond.	Gas	Dry	Service	Footage	1960	1959	Total	Crude	Cond.	Gas	Dry	1960	1959
Alabama	0	0	0	0	0	0	0	8	23	0	0	0	0	0	1	4
Arizona	0	0	0	0	0	0	0	6	. . .	0	0	0	0	0	6	. . .
Arkansas	7	3	0	0	4	0	22,724	115	180	2	0	0	0	2	31	32
California	27	16	0	1	10	0	121,478	236	301	6	0	0	0	6	56	71
Colorado	8	4	0	0	4	0	40,364	127	136	4	0	0	0	4	64	71
Illinois	24	10	0	0	14	0	55,201	460	424	9	2	0	0	7	120	69
Indiana	24	9	0	0	15	0	27,750	182	125	12	1	0	0	11	72	40
Kansas	57	30	0	1	22	4	192,674	631	742	10	1	0	0	9	189	170
Kentucky	40	9	0	21	10	0	106,077	394	341	2	0	0	0	2	46	41
Louisiana	58	24	7	4	23	0	515,800	595	682	14	1	0	2	11	86	99
North	16	6	0	4	6	0	61,869	194	250	7	0	0	2	5	37	48
South	30	14	4	0	12	0	334,191	303	361	7	1	0	0	6	44	50
Offshore	12	4	3	0	5	0	119,740	98	71	0	0	0	0	0	5	1
Michigan	13	7	0	0	6	0	51,288	134	106	5	0	0	0	5	46	34
Mississippi	20	8	1	1	10	0	210,076	143	118	7	0	0	0	7	54	58
Montana	5	1	0	0	4	0	17,120	49	55	4	0	0	0	4	26	23
Nebraska	18	4	0	0	14	0	92,230	135	126	11	1	0	0	10	57	58
New Mexico	29	10	0	4	15	0	167,341	357	314	11	1	0	0	10	54	31
West	8	2	0	4	2	0	42,993	119	. . .	2	1	0	0	1	11	. . .
East	21	8	0	0	13	0	124,348	238	. . .	9	0	0	0	9	43	. . .
New York	0	0	0	0	0	0	0	72	74	0	0	0	0	0	5	4
North Dakota	5	3	0	0	2	0	35,454	56	80	2	1	0	0	1	10	21
Ohio	18	9	0	2	7	0	37,663	227	155	0	0	0	0	0	12	4
Oklahoma	52	22	1	11	18	0	225,602	686	1,074	13	3	0	1	9	136	170
Pennsylvania	0	0	0	0	0	0	0	67	59	0	0	0	0	0	5	1
South Dakota	2	1	0	0	1	0	16,862	9	. . .	0	0	0	0	0	3	. . .
Texas	287	147	15	8	100	17	1,197,059	2,948	3,455	48	3	2	0	43	605	659
District 1	22	13	0	1	7	1	47,292	216	228	5	0	0	0	5	80	59
District 2	7	1	0	0	6	0	45,883	120	142	1	0	0	0	1	30	44
District 3	20	8	4	1	7	0	132,691	239	206	4	1	1	0	2	48	61
District 4	13	2	4	0	7	0	88,977	235	246	5	0	0	0	5	68	70
East	17	13	0	0	4	0	89,837	228	211	2	0	0	0	2	47	50
District 7-B	48	18	1	1	27	1	138,102	412	431	14	1	0	0	13	118	126
West	75	54	3	0	17	1	377,043	780	1,088	10	1	1	0	8	124	116
District 9	72	33	0	3	22	14	205,092	342	654	6	0	0	0	6	77	107
District 10	13	5	3	2	3	0	72,142	186	249	1	0	0	0	1	13	26
Utah	6	3	0	0	3	0	35,537	49	71	3	0	0	0	3	19	18
West Virginia	19	2	0	16	1	0	47,522	160	133	0	0	0	0	0	1	5
Wyoming	19	8	1	1	9	0	101,676	182	168	8	0	1	0	7	74	66
Misc. (Nev.)	1	0	0	0	1	0	2,602	6	14	1	0	0	0	1	5	11
Total U. S.	739	330	25	70	293	21	3,320,100	8,034	8,956	172	14	3	3	152	1,783	1,760
Prev. week	795	368	22	68	300	37	3,407,147	. . .	. . .	170	12	1	7	150	. . .	. . .
Cum. 1960	8,034	3,713	257	726	3,074	264	34,708,381	. . .	. . .	1,783	166	18	55	1,544	. . .	. . .
Cum. 1959	8,956	4,523	232	596	3,372	233	37,907,005	. . .	. . .	1,760	189	22	65	1,484	. . .	. . .
Western Canada	58	31	0	4	23	0	331,503	411	425	22	1	0	1	20	118	162

ROTARY RIGS OPERATING IN UNITED STATES



CRUDE-OIL STOCKS



CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

	2-27-60	2-20-60	2-28-59
Pennsylvania	2,268	2,311	2,522
Other Appalachian	1,947	1,883	1,333
Illinois, Indiana, Michigan	9,340	9,525	9,722
Nebraska and North Dakota	2,570	2,710	2,228
Kansas	9,291	9,437	8,913
Oklahoma	17,471	16,870	16,196
Arkansas	1,988	2,075	1,967
Louisiana	19,341	18,782	17,988
North	3,179	2,885	2,882
South	16,162	15,897	15,106
Mississippi, Alabama, Florida	2,924	2,667	2,366
New Mexico	7,442	7,565	9,062
Texas	108,357	106,841	115,384
East Texas	7,990	7,724	9,252
West Texas	50,422	50,255	56,183
Texas Gulf	18,593	18,742	19,964
Other Texas	31,352	30,120	29,985
Wyoming	17,228	17,589	12,776
Other Rocky Mountain	9,437	9,047	9,182
California	28,856	29,053	34,676
Foreign	†14,689	15,261	14,805
Total	**253,149**	251,616	259,120

*Bureau of Mines. †Includes 4,801,000 bbl. in California.

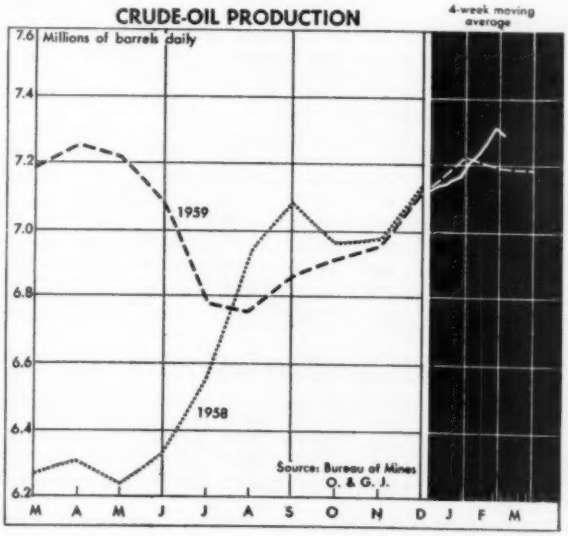
DAILY AVERAGE PRODUCTION FOR WEEK

	March 5, 1960 — Crude oil	Lease condensate	Total	Feb. 27 total
Alabama	19,325	.....	19,325	19,300
Arkansas	84,175	300	84,475	84,550
California	829,700	.....	829,700	826,300
Colorado	130,700	.....	130,700	130,000
Eastern	37,000	.....	37,000	38,400
Florida	1,225	.....	1,225	1,150
Illinois	213,700	.....	213,700	214,600
Indiana	33,600	.....	33,600	36,000
Kansas	†274,990	.....	†274,990	†318,340
Kentucky	67,200	.....	67,200	67,900
Louisiana	961,300	133,600	1,094,900	1,089,850
North	109,300	6,100	115,400	115,350
South	852,000	127,500	979,500	974,500
Michigan	31,800	.....	31,800	28,800
Mississippi	134,925	4,225	139,150	145,225
Montana	79,400	.....	79,400	77,600
Nebraska	63,500	.....	63,500	63,800
Nevada	100	.....	100	100
New Mexico	302,875	8,500	311,375	304,600
North Dakota	60,600	.....	60,600	60,000
Oklahoma	†551,900	.....	†551,900	†567,800
Texas	2,635,725	91,625	2,727,350	2,796,225
Dist. 1	41,000	3,500	44,500	44,800
Dist. 2	116,150	9,100	125,250	128,200
Dist. 3	337,850	38,000	375,850	393,500
Dist. 4	190,000	17,000	207,000	205,800
Dist. 5	28,150	500	28,650	27,500
Dist. 6	116,150	10,000	126,150	128,400
East Texas Field	142,425	.....	142,425	147,000
Dist. 7-B	137,850	300	138,150	139,200
Dist. 7-C	128,300	3,525	131,825	133,625
Dist. 8	1,097,850	6,000	1,103,850	1,144,600
Dist. 9	192,000	2,400	194,400	194,200
Dist. 10	108,000	1,300	109,300	109,400
Utah	93,600	.....	93,600	110,900
Wyoming	347,700	.....	347,700	349,800
Others	‡1,350	.....	‡1,350	‡1,300
Total U. S.	6,956,390	238,500	**7,194,640**	7,332,540
Change from prev. week, down			**137,900**	
Canada	†618,500	.....	†618,500	†578,000

Total U. S. prod., January 1-March 5 ..... 470,368,700 bbl.
Same period last year (crude plus cond.) ..... *461,396,000 bbl.

*Includes 12,656,600 bbl. condensate. †Week ended previous Monday. ‡Alaska and South Dakota.

CRUDE-OIL PRODUCTION



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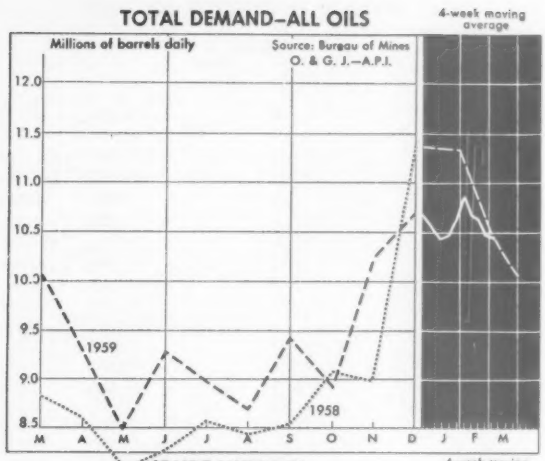
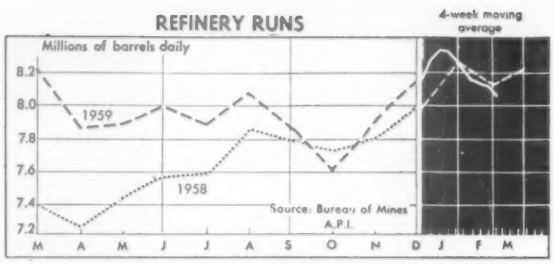
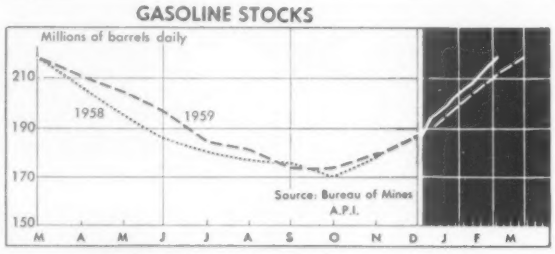
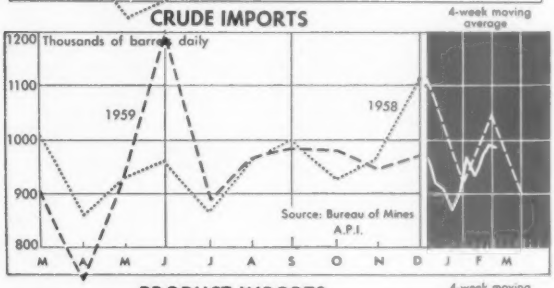
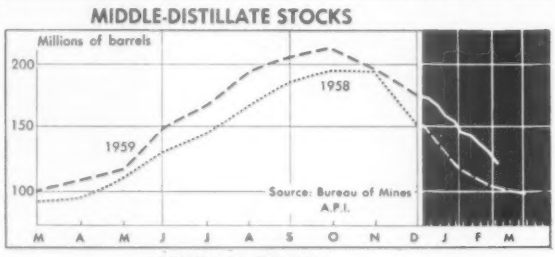
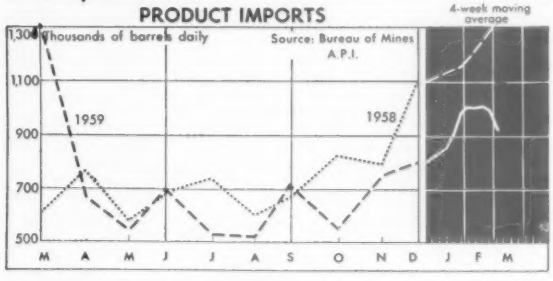

TOTAL DEMAND–ALL OILS
4-week moving average
Millions of barrels daily
Source: Bureau of Mines O. & G. J.—A.P.I.
1959
1958
M A M J J A S O N D J F M

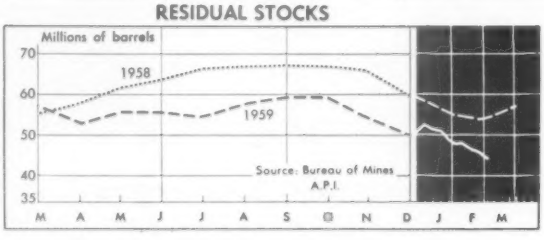












API REFINERY REPORT—MARCH 4, 1960

(Thousands of barrels)

District—	Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1959 Daily avg. runs	Daily average production Gaso.*	Kero.	Dist.	Resid.
East Coast	1,081	530.2	28.7	320.4	173.0	45,631	8,406	37,248	12,320	1,202	534.5	49.1	394.9	191.5
Appalachian:														
District 1	95	34.6	4.9	18.3	10.9	5,891	571	2,494	274	104	41.6	4.6	24.6	10.6
District 2	109	56.4	8.9	17.6	16.0	3,146	386	987	394	103	48.0	8.2	17.2	18.3
Ind., Ill., Ky.	1,457	716.0	64.6	288.3	180.7	41,716	3,949	16,199	4,347	1,519	759.1	72.3	332.3	192.4
Minn., Wis., Dak.	102	44.7	.71	23.3	22.1	7,169	639	4,371	567	103	50.0	5.4	25.8	10.6
Okla., Kans., Mo.	725	399.2	19.0	152.1	35.6	22,922	933	7,924	940	738	395.8	13.7	184.3	26.2
Inland Texas	284	191.3	8.0	42.3	21.6	8,344	402	1,465	2,433	272	200.4	6.2	41.2	21.9
Tex. Gulf Coast	1,866	997.1	87.1	455.7	131.7	27,018	2,185	10,802	4,899	1,927	925.8	100.4	488.7	181.8
La. Gulf Coast	674	348.1	42.1	139.6	41.0	11,815	1,726	3,958	1,062	700	379.2	31.2	187.5	51.1
N. La. and Ark.	107	39.4	8.1	19.7	5.7	6,186	744	2,459	194	102	49.2	5.0	24.1	6.3
Rocky Mtn.:														
New Mexico	24	15.9	.57	4.1	3.1	798	73	151	151	25	12.5	.50	4.4	2.5
Other	301	143.1	5.4	65.1	32.9	7,731	243	2,557	973	295	134.6	3.8	63.5	38.6
West Coast	1,097	546.3	2.3	166.6	267.3	30,571	333	10,939	15,530	1,117	499.7	5.5	198.9	298.7
Mar. 4, 1960	7,922	4,062.3	280.4	1,713.1	941.6	218,938	20,590	101,554	44,084	8,207	4,030.4	305.9	1,987.4	1,050.5
Feb. 26, 1960	8,108	4,090.4	290.3	1,884.0	997.1	215,623	21,878	108,815	45,299	.....	.....	.....	.....	.....
Mar. 6, 1959	8,207	3,923.0	341.9	2,157.6	1,071.4	207,015	18,985	80,616	54,835	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

End-of-the-season trend is toward bartering

THIS IS THE swapping season. If you can't sell it, swap it for another product. Despite the colder-than-normal weather at the end of the winter season, some refiners have more distillate than they want to carry through the summer. They would like to trade if they can't sell.

There also seems to be some pressure for bartering from the marketing end of the business. With all of the talk about high product inventories and needed cuts in refinery runs, management in integrated companies favor limiting product purchases by the sales department unless some other product can be sold to offset the purchase.

So the word is passed to the sales department. "If you need some No. 2 fuel, don't buy it. Swap some gasoline for it."

Product markets on the Gulf Coast are inactive. There have been no sound inquiries for products reported over the past week. Market observers say that a buyer with a tanker ready to load could find gasoline at 0.5 to 0.75 cent under the posted market prices. The higher discounts probably would be on the higher-octane grades.

The true spot price for No. 2 on the Gulf Coast is the price which some East Coast marketer would pay for a cargo that is already loaded and en route without a buyer. A Gulf Coast refiner wouldn't start a cargo to the East Coast without a home unless he is willing to take at least 0.5 to 0.75 cent a gallon under the posted 8.0-cent price.

The distillate market in the Group 3 area isn't quite as soft as it is on the Gulf Coast. Some spot No. 2 is selling for 8.25 cents a gallon, but more is moving at 8.5 cents. However, Group 3 material can't move into Chicago at either price. Market rumors indicate that the new Chicago price of 8.75 cents is subject to 0.5-cent discount.

On the Group 3 market, No. 1 fuel still is firmer than No. 2, but there have been no reports of calls for either No. 1 or kerosine on the river. River markets tend to reflect conditions on the Gulf Coast.

Crude-Oil Prices

GRAVITY SCHEDULE

	Signal Hill, Calif.	Oklahoma	Gulf Coast Tex.*	West Tex.† N.M.	Wyo. (sour)
14-14.9	$1.76	....	....	....	....
15-15.9	1.84	....	....	....	$1.81
16-16.9	1.92	....	....	....	1.86
17-17.9	2.00	....	....	....	1.91
18-18.9	2.08	....	....	....	1.96
19-19.9	2.16	....	....	....	2.01
20-20.9	2.24	$2.49	....	$2.35	2.06
21-21.9	2.32	2.52	....	2.38	2.11
22-22.9	2.39	2.55	....	2.41	2.16
23-23.9	2.46	2.58	$3.44	2.44	2.21
24-24.9	2.53	2.61	3.46	2.47	2.26
25-25.9	2.60	2.64	3.48	2.50	2.31
26-26.9	2.67	2.67	3.50	2.53	2.36
27-27.9	2.74	2.70	3.52	2.56	2.49
28-28.9	2.81	2.73	3.54	2.59	2.54
29-29.9	2.87	2.76	3.56	2.62	2.59
30-30.9	2.93	2.79	....	2.65	2.63
31-31.9	3.00	2.82	....	2.68	2.67
32-32.9	3.06	2.85	....	2.71	2.71
33-33.9	3.12	2.88	....	2.74	2.75
34-34.9	3.17	2.91	....	2.77	2.79
35-35.9	3.22	2.94	....	2.80	2.83
36-36.9	3.27	2.97	....	2.83	2.87
37-37.9	3.31	2.99	....	2.86	2.89
38-38.9	....	3.01	....	2.89	2.91
39-39.9	....	3.03	....	2.92	2.93
40-40.9	....	3.05	....	2.95	2.95

*Low cold test crude. †Sour.

Effective dates of broad changes: California, 9-11-59; East of California, January 3-10, 1957; Pennsylvania Grade 1-11-60.

FLAT PRICES

Louisiana:	
Sweet Lake	$3.00
Texas:	
East Texas	3.05-3.25
Conroe	3.23-3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.55
Middle District	4.37
Southwest Pennsylvania	4.10
West Virginia	3.92
Buckeye Grade	3.77
Illinois Basin	**3.00**

FOREIGN

Canada:	
Leduc-Woodben	2.53
Redwater (Alta.)	2.42
Smiley (Sask.)	2.18
Pembina	2.38
Venezuela:	
Cumarebo, 48°-9°, Tucupido	3.34
San Joaquin, 41°-41.9°, Puerto La Cruz	3.08-3.10
Oficina, 35°-35.9°, Puerto La Cruz	2.80
Tia Juana medium, 26°-26.9°, Amuay*	2.30
Quiriquire, 16.0°-16.4°, Caripito	2.10
Lagunillas heavy, flat, Las Piedras*	2.10
Bachaquero, flat, 15°-16°, Las Piedras*	1.88

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes f.o.b. lifting port):	
Arabian, about 34°, Ras Tanura	$1.90
Iranian, 34.0°-34.9°, Bandar Masur	1.80
Iranian, 34.0°-34.9°, Abadan	1.81
Iraq, 36.0°-36.9°, Fao	1.82
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.67
Qatar, about 41°, Um Said	2.05
Middle East, E. Mediterranean:	
Arabian, about 35°, Sidon	2.29
Iraq, about 35°, Tripoli, Banias	2.29
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.57

Refined-Product Prices

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
★ Regular (91 octane)	10.75-11.00
★ Premium (99 octane)	13.25-13.75
Natural gasoline (26-70)	4.5
Breckenridge	4.0
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	10.25-10.50
Regular (92 octane)	10.50-10.75
Premium (98 octane)	11.75-12.00
California (rack) Los Angeles):	
Regular (88 octane)	11.65-12.15
Premium (94 octane)	12.65-13.15
Premium (100 octane)	14.00-14.65
Caribbean area (cargoes):	
Regular (87 octane)	10.125
Premium (97 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
★ Kerosine 42-44	9.25-9.75
★ Diesel oil (58 d.i. and above)	9.00-9.50
★ Distillate No. 1	9.00-9.50
★ Distillate No. 2	8.25-8.50
Gulf Coast (cargoes):	
★ Kerosine 41-43	8.75-9.00
★ Distillate No. 2	7.75-8.00
New York Harbor (barges):	
★ Kerosine 41-43	9.8-10.3
★ Distillate No. 2	8.8-9.3
★ Diesel fuel, 48-52 d.i.	9.1-9.6
Caribbean area (cargoes):	
Distillate No. 2	8.00

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$1.70-1.80
Gulf Coast (cargoes):	
Bunker C fuel	$2.00
New York Harbor (barges):	
Bunker C fuel	$2.37
Caribbean (cargoes):	
Bunker C	$2.00
California (rack):	
Bunker C fuel, Los Angeles	$2.15

Tanker Rates (Long Ton)

(Latest reported spot fixtures)

★ Gulf-N. Y., clean (ATRS—28%)	$2.05
★ Gulf-N. Y., dirty (ATRS—27.5%)	2.07
★ Carib.-N. Y., dirty (ATRS—62.5%)	1.03
★ PG-Japan, dirty (USMC—67.5%)	3.32

★Denotes change from previous week.

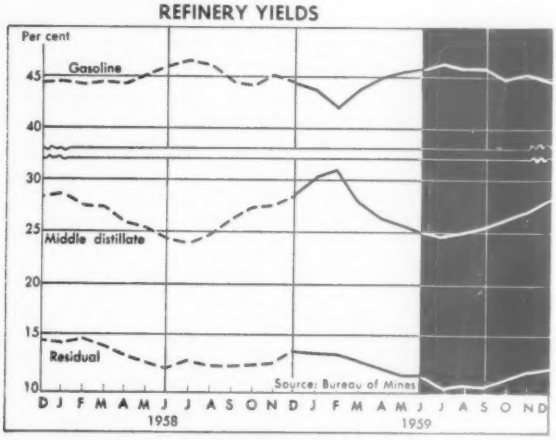
SELECTED MONTHLY DATA

SUPPLY AND DEMAND—MAJOR PRODUCTS
(Thousands of barrels daily)

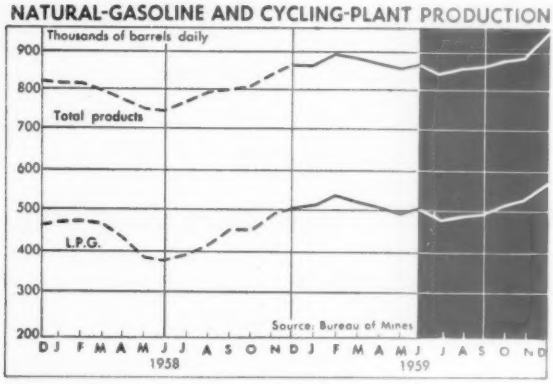
	Total demand	Refinery production	Stocks end of period†
GASOLINE			
February 1960*	3,720	4,080	217,500
January 1960*	3,680	4,100	204,600
December 1959	4,044	4,154	187,115
March 1959	3,880	4,030	218,612
February 1959	3,623	3,939	210,367
KEROSINE			
February 1960*	435	315	21,150
January 1960*	450	382	24,700
December 1959	514	385	26,817
March 1959	346	306	18,688
February 1959	468	417	19,725
DISTILLATE			
February 1960*	2,540	1,820	104,660
January 1960*	2,830	1,955	124,400
December 1959	2,651	1,939	151,030
March 1959	2,214	1,987	80,662
February 1959	2,677	2,159	84,071
RESIDUAL			
February 1960*	1,955	1,000	44,600
January 1960*	2,040	1,005	47,800
December 1959	1,936	1,007	53,261
March 1959	1,999	1,051	57,210
February 1959	2,135	1,125	54,178

*Preliminary. †Thousands of barrels.

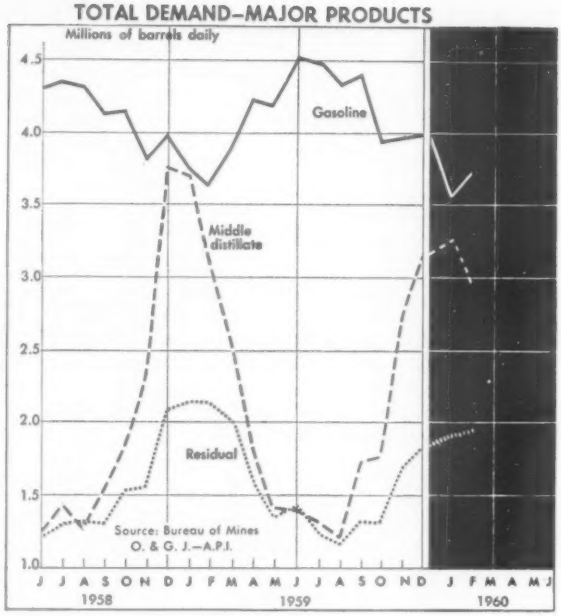
REFINERY YIELDS



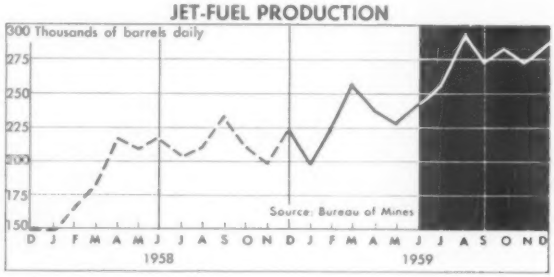
NATURAL-GASOLINE AND CYCLING-PLANT PRODUCTION



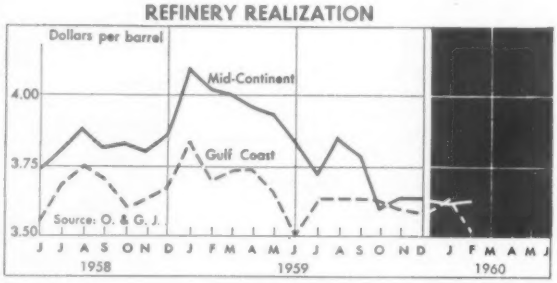
TOTAL DEMAND–MAJOR PRODUCTS



JET-FUEL PRODUCTION



REFINERY REALIZATION



REFINERY REALIZATION

	Feb.* 1960	Jan.* 1960	Dec. 1959	Feb. 1959
Mid-Continent	$3.63	$3.59	$3.63	$4.02
Gulf Coast	3.51	3.63	3.64	3.69

*Preliminary. Refinery realization is based on yields of major products and average spot prices of regular gasoline, kerosine, No. 2 fuel, and residual as published in The Oil and Gas Journal.

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FOR SALE EQUIPMENT

18" AND 20" good used pipe. Very attractive prices. Contact: The Tri-State Pipe Co., Bellaire, Ohio. Telephone OR 6-1452.

1 HYDRAULIC CASING pulling machine, complete. Price $6,500. Sell or trade. Woodford Supply Company, P. O. Box 84, Phone CE-51454, Oklahoma City 1.

ANSWER

to Worthington "Hidden Value" Puzzle on Page 33

The fictitious "hidden value" is *Adjustable Roller Main Bearings*. The design of any balance opposed compressor makes roller bearings impractical from a maintenance standpoint. Worthington balanced opposed compressors use centrifugally cast sleeve bearings which can be removed for inspection or maintenance without disturbing the crankshaft or removing the connecting rod from the frame.

PIPE FOR SALE
15,000 ft., 5½" OD-15.5#, J55, Long Coupling
5,000 ft., 7" OD-20#, J55
10,000 ft., 2⅜" OD-4.7#, J55, EUE Tubing
Sucker rods, line pipe, tanks and pumping units.
All No. 1 Grade—Used
29,000 ft., 4½" OD-15.5#, S5, 30 ft. PE Tubing—New
Lundquist Pipe & Supply Co.
325 Wright Bldg., Tulsa, Okla., Phone LU 5-8850

FOR SALE EQUIPMENT

1 BUCYRUS—ERIE 36L Spudder, late model. Rig complete with tools and equipment. Cassel Drilling Co., Inc., Dumas, Texas. Phone WE 5-5019 or WE 5-4369.

1-Type C-350 National Ideal 7¾" x 18" duplex slush pump equipped with standard 64" 20-D section sheave, Rebuilt Condition. O'Neal Taylor & Company, Box 22021, Houston 27, Texas. Phone GY 98112.

LIQUIDATION

at ESSO REFINERY Balto., Md.

BLOWERS Cent. 28,000 CFM at 17 Psig.
COMPRESSORS, Clark Gas RA-5; Clark Cent. 7,860 CFM 2 Stage
CONDENSERS 7,500 to 100 sq. ft.
REBOILERS 2,700 to 450 sq. ft.
HEATER TUBES Chrome 4" to 6" O.D.

FLUID COKER 10,000 BBL./DAY

PRESSURE VESSELS 3' to 12' Dia.
TOWERS 2' 6" to 12' Dia.
PUMPS Hot Oil, Steam, Centrifugal
INSTRUMENTS Controllers, Recorders Indicating & Transmitting

WRITE FOR CATALOG

HEAT & POWER CO., Inc.

60 E. 42 St., N.Y. 17, N.Y.
306 Thompson Bldg., Tulsa 3, Okla.
Boston & Haven St., Box 5203, Baltimore 24, Md.

FOR SALE EQUIPMENT

FOR SALE OR LEASE: Three (3) large perforating trucks complete with 16,000' of 7/16" single conductor line. These units are ready for the field. Box L-614, The Oil and Gas Journal, Tulsa, Oklahoma.

WELL DRILLS—CORE DRILLS. Everything for well and core drilling in both new and used equipment at money saving prices. Fishing tools rented. Send for bulletins. Pressey & Son, Pueblo, Colo.

Cardwell RL, Serial 679, powered by 145 GK Waukesha, Serial 862887. Skid mounted, double 55 foot poles, spudding attachment, 4,000 feet of new ¾" left lay drilling line and approx 4,000 feet of 9/16" sand line. Rig is in good condition and ready to work. Price for rig alone $5,500.00, with tools $7,000.00. Located at our yard Redfield, Iowa. Kirby Well Service, Inc. 5107 Center St. Omaha 6, Nebraska, Tel. # WAlnut 3575.

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AMOCO REFINERY DESTREHAN, LA.

BOILERS, 5—70,000 #/hr. 450 Psi.
HORTONSPHERES, 6—5,000 & 10,000 bbl.
EXCHANGERS, 78 to 4,000 sq. ft.
TOWERS, 3 ft. to 12 ft. diameter.
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FURNACES, 15 MM & 34 MM BTU/hr.

19,000 BBL. MIV CAT CRACKER

CENT. COMPRESSORS, 38,000, 9,370 & 5,535 CFM.
CENT. PUMPS, 15 to 7,000 GPM.
TURBINES, 5 to 1,400 HP.
INSTRUMENTS, Indicating, Recording & Transmitting.
TANKS, 1,000 to 80,000 bbl.
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1 —USED 127' Lee C. Moore Bolted Type Mast Mounted on 7' high Substructure. Located Oklahoma City. Price $11,000.00

1 —USED Gardner-Denver FZ-FXZ 7¼" x 12" Pump. *Reconditioned.* Located Odessa. Price $5,500.00.

2 —USED Waukesha 6NKU Engines with Starter Engines and Butane Equipment. *Good condition.* Located Odessa. Price $2,000.00 each.

1 —USED Caterpillar D-13000 Diesel Engine with Starter Engine. *Completely reconditioned.* Located Odessa. Price $1,250.00.

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COMPRESSOR CYLINDERS for most makes of Gas Engines—over 1,000 listed. C. J. Smith, 305 Oil Capital Building, Tulsa 3, Oklahoma.

BUDA POWER UNITS: Unused surplus, new condition. Four cylinder, 121 HP gasoline engines. Complete with radiator. Twin disc clutch and 5 sheave V-belt drive pulley. Can be operated on LP or natural gas. Priced at fraction of cost, $1,495.00 each. Photograph and complete specifications on request. Oldfield Equipment Co., 430 West Seymour Ave., Cincinnati 16, Ohio.

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2,000,000 ft.	2"	3.50# to the ft.
1,000,000 ft.	3"	7.70#
1,000,000 ft.	4"	10.98#
500,000 ft.	6"	19.80#
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400,000 ft.	10¾"	35#
75,000 ft.	12¾"	40#
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All No. I Grade plain end and cleaned.

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1 Moore Steam Turbine #4832—9 Stage—Form S-202-7-4 1,050 H.P. Exch. 26" Vac. 4" Steam inlet—uses 14,490 lb. steam per hour—26" Exh. vacuum at 2,000 RPM

1 Worthington Barometric Jet Condensor

2 Five Ton Capacity—20' span Traveling Bucket Cranes

2 Clark Compressors—Gas—13½" Stroke—14" Bore

54 Complete assortment HEAT EXCHANGERS, on grounds, will be ready for inspection at your request. Steel-Admiralty-Red Brass-Chr. Moly-Chrome Tubes 170 to 2,205 sq. ft.

Towers—from 3 ft. to 12 ft. in diameter
Pumps—centrifugal to 1,200 GPM
Vessels to 10' in diameter

CALL—WRITE—PHONE
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FOR SALE EQUIPMENT

FOR SALE—Approx. 150,000 ft. 6⅝" O.D. 18.97# Used Line Pipe, S. R. L. Bevelled for Welding. Address inquiries P. O. Box 2205, Tulsa, Oklahoma.

FOR SALE: 3⅛ drilling interests to 3,750 feet, Reno County, Kansas. Offsetting good producing well. Have Geological report. Shigley: 1864 North Alexandria, Hollywood 27, California. NO. 3-5410.

FOR SALE: Three "114" and one "160" Cabot Pumping Units. Frogge Equipment Co., 630 S.E. 29th St., Oklahoma City, ME 2-0401, ME 4-5518, MU 5-1630.

ASPHALT UNIT—1,000-barrel capacity consisting of vacuum pump, complete with vacuum jugs and 2 vacuum towers, 20-horsepower GE 22/440 volt motor; one 3,000-barrel and two 2,000-barrel all welded tanks insulated; miscellaneous asphalt heaters; cooling tower; loading racks; lab equipment, etc. Write Box 637, Hardin, Montana. Phone 642.

FOR SALE—Excellent Water Flood Prospect, Located Old Somerset Field, Atascosa County, Texas. Leases are ⅞ and adjoining. 2,600 acres of the 3,000 acre block are unitized.
Three producing and one input well on premises.
Best sand is Olmos at 1,500'. Sand thickness 20-30'. Oil in place, 1,200 bbls. per acre foot with 600 estimated receivable with effective water flood. Treated salt water moves oil through cores.
Interested buyers may make contact in person only.
Texas Drillers, Inc., P. O. Box 47, Seguin, Texas. Ph. FR 9-5131.

75,000'—8⅝" OD 28.55# PE beveled used No. 1 line pipe.

25,000'—8⅝" OD 28.55# Collar w/dutchman

A. A. Gilbert Pipe & Supply Company
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4 STAGE COMPRESSORS

Chicago Pneumatic Model PO-44 82 CFM Pressures to 3,000 PSI—For Hydrogen, Natural Gas, Air, Etc.—Powered By Cat D 318 Diesel Engine—Trailer Mounted. Fully Guaranteed. Call-Wire or Write: Brochure on Request.
Forbes Motor Co. Monroeville, (PGH) Pa.

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Bring your propositions to:
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PACKAGED GAS COMPRESSORS

6 HBGG Worthington units complete with 150 h.p. NKR Waukesha engines.

2—17" x 13" single units
2—11" x 13" single units
2— 7" x 13" single units

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LUther 7-6204
Tulsa, Oklahoma

FOR SALE EQUIPMENT

8,350 ft. 2⅞" EUE seamless 8R thread, used tubing: 60 cents per ft. 3,000 ft. 2⅞" ditto, 10 thread: 55 cents per ft. Located Elk City, Okla. 1,200 ft. 4" O.D. full hole drill pipe: 60 cents per ft. Located Blackwell, Okla. Carman Supply Co., Phone RIverside 2-3502, 1008 E. 36th St., Tulsa.

5,000 FT. of 16" O.D. 31# Weight Spiralweld Steel Pipe in 40 Ft. R/L. Suitable for surface casing, pressure lines, drainage or road crossing pipe. Good used condition. Price, $3.00 foot F.O.B. our yard. Write or phone: M. Kaplan & Sons Inc., Monroe, Louisiana, FAirfax 2-5112.

FOR SALE: Oil loading rack, six railroad cars 200 ft. long, complete with 4 inch supply pipe, 3 inch laterals, valves and swing pipe. Fair Oil Co., Box 689, Tyler, Texas, Telephone LY 2-3811.

8 Mack Tractors LEVSW (modified) 600 H.P. Cummins. With or without 10 ft. x 40 ft. Insulated Trailers. These Trucks are 202 inch Wheelbase, 10 ft. width. Tires 16.00 x 25. 5 Trucks in Montana & 5 Trucks in Anchorage, Alaska. Write P. O. Box 1410, Fairbanks, Alaska.

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WANTED: 59 H.P. Reda pump complete, in working condition. Box L-760, The Oil and Gas Journal, Tulsa, Oklahoma.

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NEW OIL JOB Directory, foreign and domestic, showing where to apply for jobs. 500 selected producing, refining, butane and pipeline companies. Nationwide, $6.00 cash. OIML Co., Box 2603, Tulsa, Oklahoma.

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NEED FOREIGN sales representation for our complete line of new and revolutionary gas lift equipment. Excellent commissions. Box L-759, The Oil and Gas Journal, Tulsa, Oklahoma.

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Diversified engineering and construction group engaged in world-wide projects has opportunity for process engineer with minimum 3 years experience in gasoline plant design and related operations. Inquiries held confidential. Contact:
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The Fish Engineering Corp.
796 M & M Bldg. Houston, Texas

SITUATIONS WANTED

PERSONNEL DIRECTOR, 10 years experience personnel director medium sized oil company. Organized, developed, administered program including employment, benefits, safety, personnel policies, organization planning, other related areas. Close contact all levels management, field and office. Box L-740, The Oil and Gas Journal, Tulsa, Oklahoma.

PRODUCTION SUPERVISER, 50, 31 years with major oil company. Experience in drilling and producing in Gulf-Coast, South, Central, West Texas and Louisiana Gulf-coast and off-shore. Roustabout to Production Superintendent. Presently employed as a production supervisor. Desire employment with aggressive small or independent oil company. Box L-738, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

RIG MAINTENANCE Mechanic: 20-years experience. Recommendations on request. Will relocate. Call: J. E. Jones, 4714, Kilgore, Tex. or write; 406 Florey Ave.

PHOTOGRAPHER: 7-years experience oil industry. Public relations, advertising. Stills, movies, color, processing, training films. Presently employed. Box L-744, The Oil and Gas Journal, Tulsa, Oklahoma.

GASOLINE PLANT superintendent— Age 44, 25 years experience in all phases of the gas industry, including construction operations, maintenance. Furnish references. Available immediately. Box L-743, The Oil and Gas Journal, Tulsa, Oklahoma.

MUD ENGINEER: Recently completed 2 year contract in North Africa. Working knowledge of Arabian language and customs. Information available on material sources. 12 years experience in drilling department to supplement 10 years in mud work. Passport and shots renewed. Immediately available on single status. Box L-756, The Oil and Gas Journal, Tulsa, Okla.

GEOPHYSICIST: B.S. Geology. 9 years experience includes Party Chief and review in Texas, Louisiana, New Mexico. Available. Box L-758, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPLOITATION ENGINEER—Twelve years experience reservoir, exploitation, production Mid-Continent, West Texas, Gulf Coast. Desires position with small oil company. Box L-762, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST, B.S., 29, $2\frac{1}{2}$ years subsurface, wellsite, core, and stratigraphic experience, Spanish ability. Willing to travel. Foreign or domestic. Box L-763, The Oil and Gas Journal, Tulsa, Oklahoma.

DEVELOPMENT ENGINEER and Former manager, drilling contractor's operations, South America and coordinator oil company's development program, Middle East, desires position in exploration/drilling/production in supervisory/administrative/engineering capacity domestic or overseas, or technical representative equipment manufacturer or service company abroad. Available now. Speaks Spanish, German and some French. Resume on request: Box 31R, 547, 4041 Marlton Ave., Los Angeles 8, California.

REAL ESTATE

COLO. RANCH INVESTMENT 23,440 acres grass land fully fenced, watered, improved. Close in on Hi-way. A money maker. $20. per acre, terms. E. H. Grantham, Ordway, Colo.

BUSINESS SERVICE

DELAWARE CORPORATIONS formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

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WANTED—Complete or near complete set 1"=100 electric logs for Mississippi. Box L-732, The Oil and Gas Journal, Tulsa, Oklahoma.

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HIGHEST PRICE paid for oil and gas income royalties, overrides, oil properties. A. S. Berry, 109 Midco Bldg., 302 South Cheyenne, Tulsa, Oklahoma.

PRODUCTION WANTED

$500,000-$1,000,000. GAS purchase wanted. Principals only. Engineering desired. Box L-747, The Oil and Gas Journal, Tulsa, Oklahoma.

A CALL TO ARMS!

As an independent oil and gas producer, I am tired of seeing United States markets flooded with foreign oil and gas. There is a plan afloat whereby various companies intend to take over more United States markets, with Canadian gas. Ample gas, here in the United States, already uncovered, and waiting to be uncovered, will supply all of our needs for many, many years to come. Help me in this fight to preserve United States markets for United States gas!

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P. O. Drawer 150 Beaumont, Texas

AIRCRAFT

CESSNA 195-A, 5 place, 275 H.P. Jacobs, Chrome Wall engine, cross wind gear, complete panel, ADF, omnigater, perfect, low time. Will trade for oil well equipment or casing. Luke Wise, Community Gas & Oil Co., Billings, Montana.

CAPITAL WANTED

OIL PRODUCER seeks individuals with capital who wish to make direct investments in the drilling of wells for oil and gas in areas of favorable geology. The prospects will not be wildcats but are chosen for drilling because they are near or in areas of proven production. Will supervise the drilling and completion of the wells on a cost or turnkey basis. Box L-755, The Oil and Gas Journal, Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

FIFTEEN THOUSAND acre block, state oil lease, Luna County, N.M. for sale, or will lease with drilling obligations, adjoins Major Company's leases, who will support test drilling, area on defined Structure. E. R. Wright, P. O. Box 423, Deming, N. M.

14 OIL WELLS, 5 water injection wells. 560 acres. Production, approximately 20 barrels daily. 700 ft. depth. On pipeline. Engineers say drilling additional wells will make a money making, long lived flood. Southeast, Kansas. Box L-715, The Oil and Gas Journal, Tulsa, Oklahoma.

OIL AND GAS MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2,000 acres. Write quickly to: Jefferson G. Smith, 715 Littlefield Building, Austin 15, Texas.

SALE OR MERGER—Eastern Kentucky. About 1,200 acres leases with 5 gas and 1 oil well. Also Natural gas utility with 450 customers. 1,300 acres leases with 6 gas wells and 900 more customers waiting for more gas. M. W. Kimball, 1844 Wood St., Muskegon, Michigan.

LICENSED DEALER solicits submittals of minerals for sale, wildcat or proven, East Texas only. Box L-749, The Oil and Gas Journal, Tulsa, Oklahoma.

HAVE 170 ACRES Commercial lease N.E. of Twp 13 R 12 E Okmulgee Co., Okla. For sale reasonable. George Hedges, Sr., Box 121, Pawhuska, Oklahoma.

FOR SALE or drilling interest: Arizona oil and gas leases (Federal), Coconino County, 640 acres T17N, R13E, 586 acres T17N, R14E. Write: Box L-708, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE—Eighty acre lease and pumping well. Room for three more wells, Lost Springs, Marion Co., Kansas. For inspection see Victor Hartke, Lost Springs, Kansas. Geisler Land Co., Aberdeen, South Dakota.

OIL PRODUCING property wanted in western Pennsylvania. Send full particulars. P. O. Box 105, Bergenfield, New Jersey.

CLINTON COUNTY Kentucky hotspot—135 acre farm-out. Small cash bonus and override. Sell 86 acres and 240 acres. $30.00 per acre cash $30.00 Oil payment 1/16 override. Write: Box L-761, The Oil and Gas Journal, Tulsa, Oklahoma.

CUMBERLAND COUNTY Kentucky—118 acres on Judio Dome, near new shallow production. 5 year term $1.00 rental bonus. Price $20.00 per acre, 1/16 override. Wire, phone: W. V. Cravens, Alpine Motel. Burkesville, Kentucky.

NORTH CENTRAL TENN. 2 blocks good geology, one 2,100 acre. One 1,600 acre. Both partially proven. 7 known sands from Surface to Knox 1,600'. Farm-out retain small over-ride and some cash. D. W. Polkinghorn, 5842 Mission Road, Mission, Kansas.

SECONDARY RECOVERY

Lab analysis of cores from recent well indicate 10,000 to 20,000 Bbls. of pipe line oil left in formation after primary period. Depth 1,600'. Can be flooded or mined. This is not an offer for sale.

IMPERIAL-CRAIG CO.
Kevin, Montana

BUSINESS OPPORTUNITIES

FINANCIAL Contacts, Underwriters, Private Brokers reached. No shopping. Confidential. Send details to Consultant—817—51st Street, Brooklyn, N. Y.

AGENTS WANTED throughout U.S.A. and foreign to market the Macro downhole casing testing tool. Proven in over 1,000 field tests. Excellent profit margin for very small investment. Write: Macro Limited, 534—6th Avenue S.W., Calgary, Alberta, Canada or phone Calgary AMherst 3-2839.

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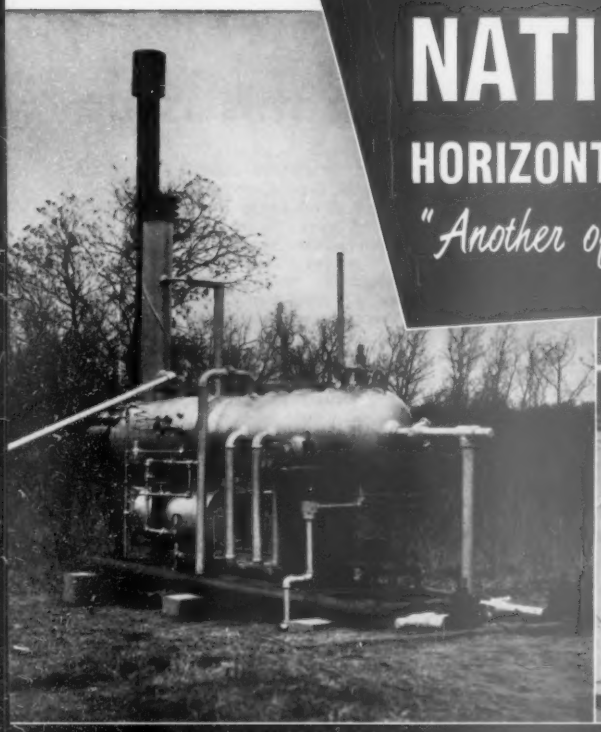
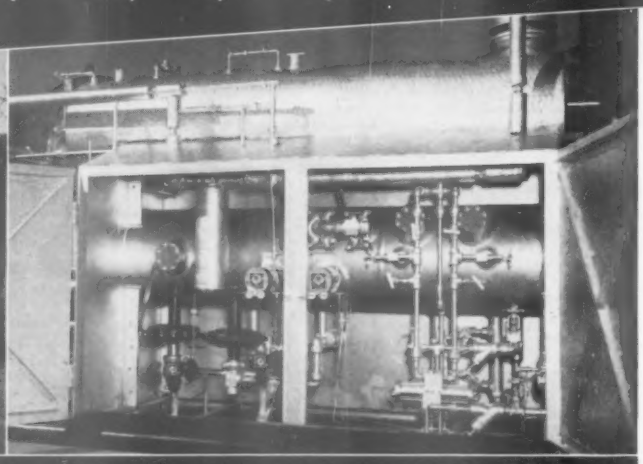


UNIT WITH INLET SCRUBBER ON STREAM NEAR OKLAHOMA CITY



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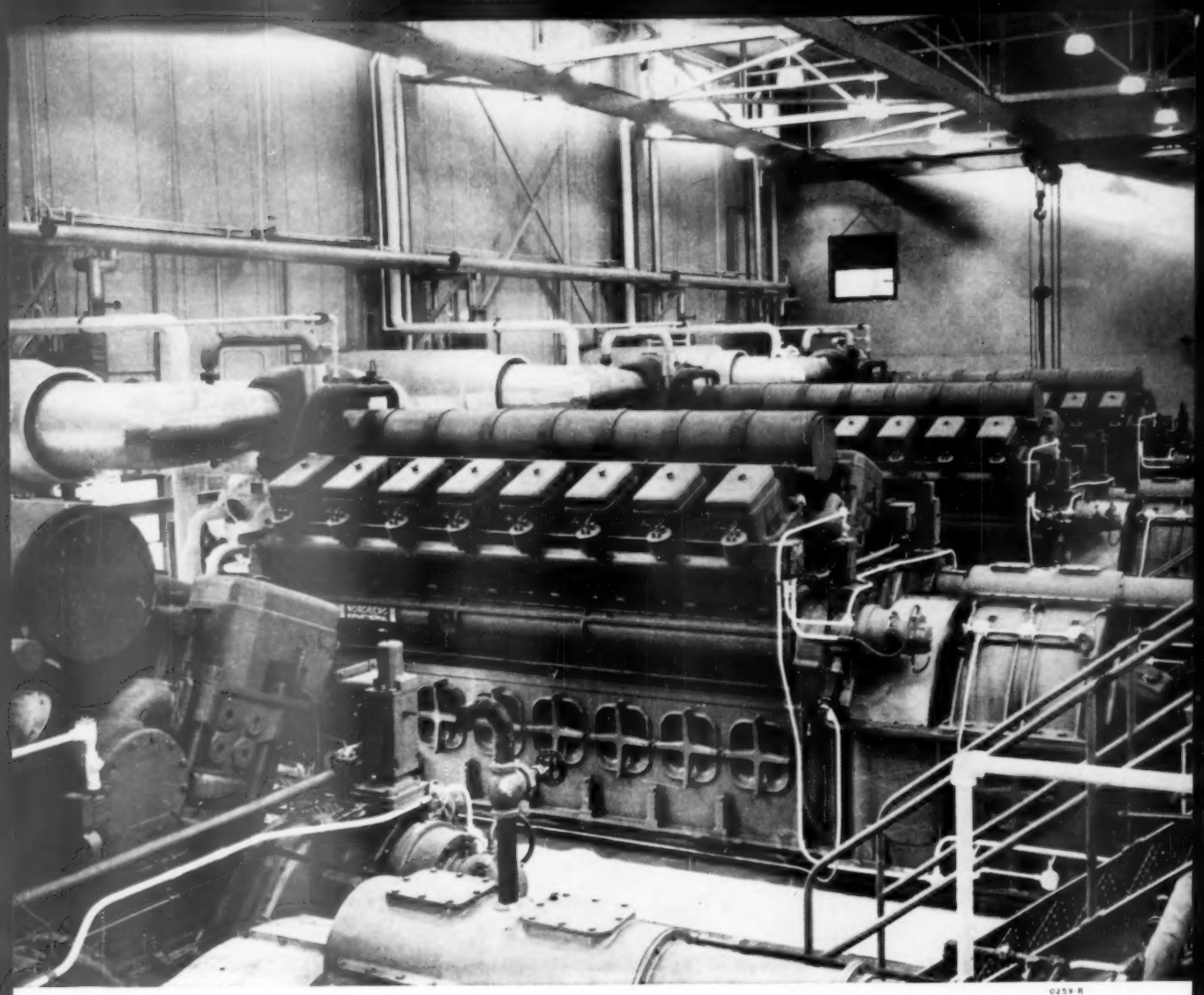

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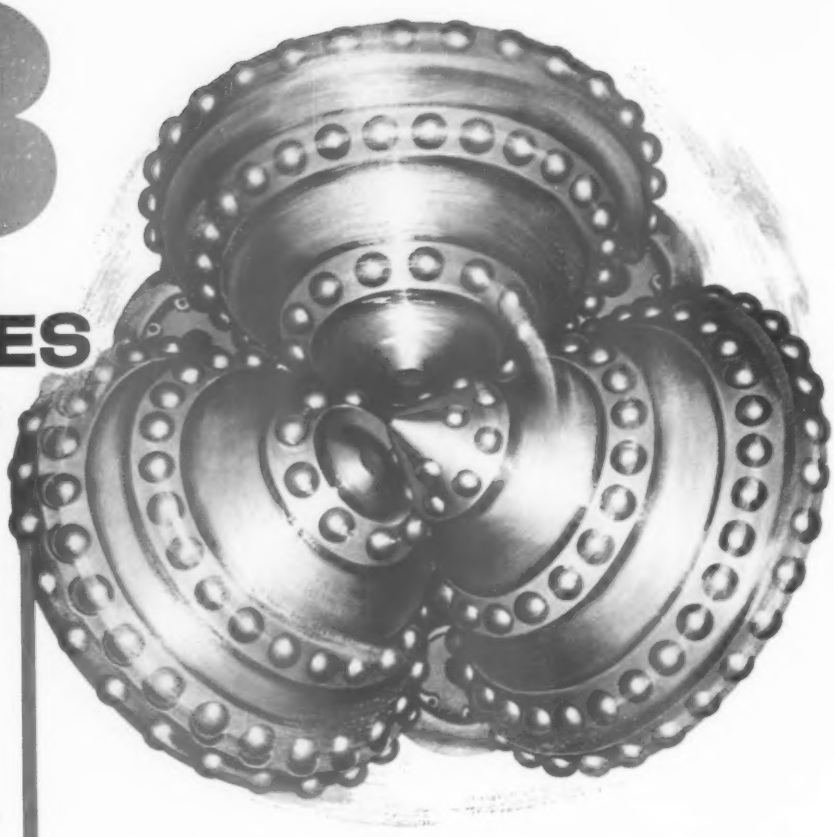

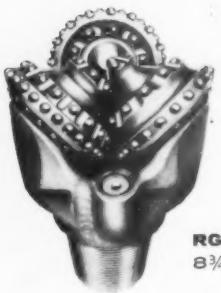

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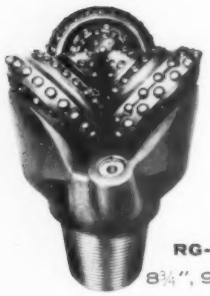
RG-1J
6" – 9"



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